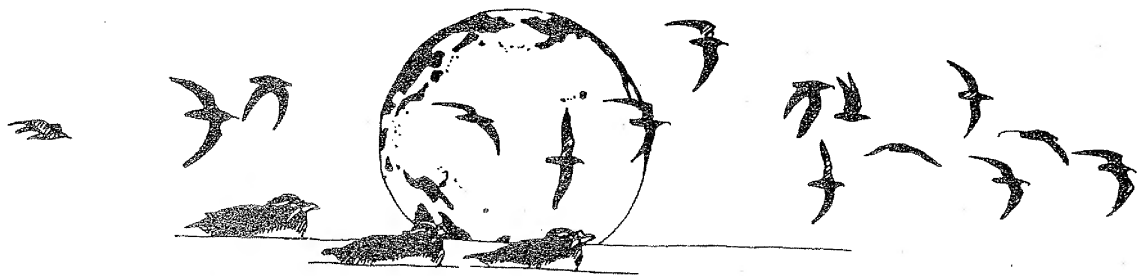


# PACIFIC SEABIRDS



A Publication of the Pacific Seabird Group

Volume 25 Number 1

Spring 1998

## **Dedicated To The Study And Conservation Of Pacific Seabirds And Their Environment**

The Pacific Seabird Group (PSG) was formed in 1972 out of a need for better communication among Pacific seabird researchers. The Group coordinates and stimulates the field activities of members involved in research and informs its members and the general public of conservation issues relating to Pacific Ocean seabirds and the marine environment. Group meetings are held annually and the PSG publication, *Pacific Seabirds* (formerly the *PSG Bulletin*), is issued biannually. Current activities include involvement in seabird sanctuaries, coastal surveys, seabird/fisheries interactions, and legislation. Policy statements are issued on conservation issues of critical importance. Although PSG's primary area of interest is the west coast of North America and adjacent areas of the Pacific Ocean, it is hoped that seabird enthusiasts in other parts of the world will join and participate in PSG. PSG is a member of the U. S. Section of the International Council for Bird Preservation. Annual dues for membership are \$20 (individual and family); \$13 (student, undergraduate and graduate); and \$600 (Life Membership, payable in five \$120 installments). Dues are payable to the Treasurer (see Membership page for details and application).

### ***Pacific Seabirds***

*Pacific Seabirds* (ISSN 1089-6317) is published twice a year, in the spring and fall, and contains news of interest to PSG members, including regional seabird research, conservation news, and abstracts of papers presented at the annual meeting. *Pacific Seabirds* is an outlet for the results of scientific research, as well as articles and shorter items on seabird conservation, seabird research activities, and other topics related to the objectives of PSG. All materials should be submitted to the Editor, except that technical manuscripts should be submitted to the Associate Editor for Technical Manuscripts and conservation-related material should be submitted to the Associated Editor for Conservation. Back issues of the *Bulletin* or *Pacific Seabirds* may be ordered from the treasurer: please remit \$2.50 each for Vols.1-8 (1974-1981) and \$5.00 each for Vol. 9 and later (see Membership Application for details and order form).

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# PACIFIC SEABIRDS

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## Forum

Visions, Specters and Future Seabird Research by <i>Alan E. Burger</i> .....	1
Some Thoughts on Marine Ornithology As A Science by <i>Anthony J. Gaston</i> .....	2
Lost At Sea - Almost: More On Seabird Mortality by <i>Michael Gochfeld</i> .....	4

## Articles

Techniques For marbled Murrelet Age Determination In The Field by <i>Craig S. Strong</i> .....	6
Hauglin's Gull In North America by <i>W.R.P. Bourne</i> .....	9

Conservation News by <i>Craig S. Harrison</i> .....	10
---	----

PSG News.....	12
---------------	----

## Regional Reports

Canada by <i>Tony Gaston</i> .....	14
------------------------------------	----

Bulletin Board .....	17
----------------------	----

Report Of The Secretary – 1998 by <i>Kathy Kuletx</i> and <i>Vivian Mendenhall</i> .....	18
--	----

Abstracts Of Papers - 1998.....	20
---------------------------------	----

Book Reviews .....	50
--------------------	----

Publications .....	51
--------------------	----

Pacific Seabird Group Committee Coordinators.....	55
---	----

Life Members, Lifetime Achievement Awards, and Special Achievement Award.....	56
---	----

Membership Application/Publications Order Form.....	57
---	----

Executive Council.....	Inside Back Cover
------------------------	-------------------

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# FORUM

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## VISIONS, SPECTERS AND FUTURE SEABIRD SCIENCE

By Alan E. Burger

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Science and conservation are the twin, intertwining pillars on which the Pacific Seabird Group has built itself. Maintaining this support base sometimes involves a delicate balancing act, and we try to position ourselves between the extremes of uninformed bird-huggers and isolationist, etherial scientists. Biological conservation cannot survive without good science. Conversely, the emotion and public interest generated by important conservation issues can stimulate excellent science (or, if nothing else, increased funding for science!).

The PSG has been successful in both scientific and conservation fields. This was obvious in Monterey as we celebrated our 25th annual meeting. The anniversary symposium organized by Dave Duffy highlighted the tremendous advances in seabird science over the past 25 years, and the roles of many PSG members at the forefront of these advances. How have scientific advances contributed to solving seabird conservation problems? Lets examine two currently hot issues involving seabirds.

The killing of albatrosses as by-catch in long-line fisheries is an international issue making front-page news, partly as a symbol of the unregulated nature of deep-sea fisheries. Concern over the deaths of albatrosses is heightened by the information provided by "pure" science, not driven by conservation or management goals. Demographic studies going back more than 50 years show that these are long-lived animals, slow to reproduce, with very low natural mortality as adults. Accidental deaths of experienced adults are likely to have serious impacts on populations, and the significant declines being recorded on several sub-Antarctic islands bear this out. Banding studies and more recently satellite tracking have shown us the amazing migrations and foraging trips that albatrosses routinely make. International action is clearly justified when it can be shown that birds with chicks on South Georgia are being killed by long-liners off Brazil.

My second example of science in conservation involves the PSG more directly. When the PSG was founded the Marbled

Murrelet was one of the least known seabirds in the world, aptly described by Charlie Guiguet as "the enigma of the Pacific". Today we are still groping to understand some of the most basic elements of the murrelet's life history, but we do have good information on nesting requirements, derived from scientific sampling, to apply to habitat conservation and management. The picture is far from complete, but at least we can convince sceptics that preserving a few stands of old-growth forest might be a good idea. The PSG has taken the lead in developing and applying scientific protocols for Marbled Murrelet research, and can take a lot of credit for the ongoing application of science in the conservation of this species.

As we reach maturity, at least in albatross years, the PSG is doing some self-examination. Tony Gaston and Julia Parrish are heading up a review of our functions as a group and our vision for the future (*Pacific Seabirds* 1997, 24(1):3-5). The PSG clearly has a healthy future, judging by the continuing rise in the number and quality of scientific papers at our annual meetings, and the excellence of student presentations. Most members will agree that we do a good job in producing publications (both this bulletin and our periodic symposia), holding congenial and stimulating meetings, and facilitating good science to deal with problems such as Marbled Murrelets or the Exxon Valdez oil spill. No doubt we will continue to do these things well. Some of us have a niggling feeling that we could do a little more, and perhaps raise our collective gaze beyond our North American navel.

Seabird science is a rare curiosity in most Pacific countries. It is, however, an urgently needed component in the preservation of several threatened seabird species and communities. Recent reviews of the global avifauna by Birdlife International (Handbook of Birds of the World) revealed that while seabirds are generally well-studied in North America and Europe, those in many countries of the Pacific are poorly known. Furthermore, many local populations of Pacific seabirds, and some entire species, are under severe threats from direct exploitation,

habitat loss, bycatch in fisheries, disturbance at colonies and other human activities. For example, several Asian species such as Saunders's Gull and Chinese Crested Terns are critically endangered due to human developments, but virtually unstudied. A review by Dave Duffy in 1992 (*Colonial Waterbirds* 15: 155-158) showed that only one-third of threatened and endangered seabirds had research or conservation efforts directed at them. The PSG's vision should be broad enough to encompass seabirds in trouble across the Pacific. Collectively, our group has the knowledge and dedication to work with local biologists and naturalists in developing conservation strategies, applying known techniques and developing new ones, while raising local awareness of the beauty and value of wild birds. Knowledge can stimulate latent biophilia in most people, and that is surely the most powerful force for conservation.

The PSG has already sponsored several scientific conservation initiatives outside the U.S. and Canada. In recent years, for example, we helped establish a program for controlling introduced mammals on seabird colonies in Mexico and collaborated with Japanese biologists to develop research on Long-billed Murrelets and other alcids in Japan. In the tropical Pacific, Mark Rauzon worked with a local conservationist Katino Te'ebati to control feral cats on Kirimati (Christmas Island, South Pacific Ocean), home to one of the last populations in the world of the Phoenix Petrel and Polynesian Storm-Petrels. My hope is that similar collaborative programs will become more common, and that at the end of our next 25 years we can look back with some pride at the application of science to conservation successes in North America and around the Pacific.

In the year ahead the PSG executive and members will identify problems involving seabird conservation in selected parts of the Pacific, focus on some appropriate, attainable short- and long-term goals, and seek seed funding to help these undertakings. As a PSG member, you can help by suggesting likely projects, contact people, and sources of funding. I hope to hear from you. The specter of neglected and



declining populations, lost colonies and even disappearing species should not be ignored while we contemplate the PSG's

long-term vision.

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sity of Victoria, Victoria, British Columbia V8W 3N5 Canada. E-mail: aburger@uvvm.uvic.ca

## SOME THOUGHTS ON MARINE ORNITHOLOGY AS A SCIENCE

By Anthony J. Gaston

During her excellent and thought provoking summary to the Pacific Seabird Group's 25th anniversary symposium, Julia Parrish posed the question, "is there a science of seabirds?" She then proceeded to answer in the negative: there was no such thing as a science of seabirds, just a lot of other 'ologies being applied variously to those birds that happen to live their lives at sea. I would like to revisit her question, not to argue that she was right or wrong, but to rephrase it as follows: "If there was a science of seabirds (we can call it marine ornithology to give it the status of an 'ology), then what would it be like?"

Firstly, what makes the different sciences distinct? Scientists like to group themselves into disciplines and within disciplines into sub-disciplines. So, the ecologists may be physiological, behavioral, or evolutionary; the physiologists may be endocrine, neural, or respiratory. The groupings are determined by common paradigms, theories and techniques and they are cemented by specialist societies and journals. At bottom, these groupings are defined by those scientists who can or want, to talk to one another, who use the same jargon, and discuss the same questions.

Then there are the taxonomic disciplines: mammalogy, entomology, herpetology. With the demise of taxonomy and systematics, these designations seem to be somewhat old-fashioned now. Few aspiring university professors will define themselves as ornithologists or mammalogists today, because to do so indicates that you take a taxon-based view of the world, whereas we are taught that we should be looking at broad generalizations in science, rather than confining ourselves within the straightjacket of a single phylum or order. This is in spite of the fact that, in reality, individual scientists confine their research to ever smaller areas of their discipline. Despite the eclipse of taxon-based sciences, the associated societies and journals seem to be doing fine, so there are obviously lots of people still doing ornithology and ichthyology. They just don't refer to themselves as ornithologists or ichthyologists, at least not to other faculty members.

How many friends and colleagues do you need to form a science? Probably not many. The avian biogeochemists can hold their convention in a taxi. Nor does the number of species involved matter: the Species Survival Commission has a specialist group for Proboscidea (2.5 species extant). What you need to qualify as a discipline, or a field (depending on your nomenclature) is an area of research that is unique in its framework, its idea and its techniques. Conference are held on the biology of *Drosophila*, not because there are a lot of species (many insect genera have as many), but because *Drosophila* happens to be the tool of choice for a certain brand of experimental genetics. Chimpanzees get their own conferences, not because they are smart (so are ravens), but because they share 97% of their genotype with people and people are a major concern of medical science. Bryologists are rare, but form a separate discipline because other botanists only need reading glasses and hand-lenses, while bryologists need microscopes. How does the study of seabirds rate in terms of distinctness from other areas of science, especially other areas of ornithology?

Marine ornithology has two components: one is taxonomic (it is about birds) the other environmental (it is about birds in the marine environment). Seabirds have a taxonomic definition (Procellariiformes, Sphenisciformes, Pelecaniformes, and selected Charadriiformes: gulls, terns, skimmers, skuas, jaegers and auks, with phalaropes and sheathbills sometimes included as honorary members). These are the birds that Robert Cushman Murphy, W.B. Alexander, James Fisher, Ronald Lockley, and Philip Ashmole wrote about in the books that served to define the field. When Peter Harrison wrote his pathbreaking identification guide he included loons and grebes, but I think this was because he wanted people to be able to identify all the birds that they saw at sea, rather than because he thought of them as "seabirds".

If we look at the families and genera

that comprise the taxonomic category "seabirds", is there something that they have in common with one another that makes them distinct from the many other birds that we may find in the marine environment (grebes, loons, ducks, geese, shorebirds, herons, kingfishers, etc.)? The answer to that has to be equivocal. Only the petrels, penguins, auks, frigatebirds, tropicbirds and boobies are completely marine throughout the year at the level of families or subfamilies. There are many gulls, terns and cormorants that are marine throughout their lives, but then that also applies to some seaducks (eiders, oldsquaw), some shorebirds (Oystercatchers, Crab Plovers, some plovers, Reef Heron). Conversely, some species of gulls, terns, pelicans and cormorants visit the sea only occasionally, if at all.

Most seabirds are found away from the shore, many even out of sight of land. Once we move, say, 1 km offshore, we encounter few birds not included within the taxonomic definition of seabird: principally the eiders and a few other seaducks, and some loons (especially Pacific Loon). So seabirds seem to be those families that may be found well away from the shore, with a few exceptions. Hence, marine ornithology becomes "the study of birds adapted to living at sea, well away from land (but not including eiders)". This is rather an ugly definition, perhaps, but one that seems to fit the customary usage of the term.

There seems to be something about seabirds that promotes their separation from other birds in the minds of their students. What is it about birds that live at sea that makes them distinct from other birds and hence encourages marine ornithologists to form separate societies and produce their own specialist journals? First, consider breeding biology: practically all seabirds are colonial, compared to only a small percentage of land birds. When we study the breeding behaviour of seabirds we are dealing with problems such as information centers, extra-pair copulations, parent-offspring recognition, prostitution, predator mobbing, cliff-nesting, nocturnal or fossorial breeding, that otherwise apply

to only a small proportion of birds and to hardly any other vertebrates. On the other hand, we don't usually worry about song, territoriality, cryptic nest sites, camouflage or predator avoidance behaviour.

Likewise, consider habitat selection and community ecology. Habitat selection for land birds is, for the most part, about structural features of vegetation. The vegetation is, for many birds, the matrix in which they live. At sea, once we get away from shoreline features, there is little physical structure. Instead, the variation in seabird habitat is created by variations in temperature and salinity which structure the marine food webs of which seabirds form a part. As far as community ecology is concerned, the type of niche differentiation that separates species of forest birds, based on nuances of foraging behavior: twig-gleaners, versus sallying flycatchers, bark probers vs drillers, are reduced to the single fundamental constraint of diving performance. In many communities of sympatric seabirds the principle prey is common to most species, something normally seen on land only during vole plagues or budworm and locust outbreaks. This observation has led to the notion that competition among seabirds, if it occurs, must be of a rather transitory type.

Notice that both the fields that I have instanced (breeding biology, habitat selection) set seabirds apart from the otherwise marine birds of the intertidal and nearshore zones: the latter are not necessarily colonial and their habitat ecology is similar to that of landbirds in taking cues from structure (sandy vs rocky shores, kelp beds, muscle beds, etc.). Of course, there are always exceptions. The study of breeding Marbled Murrelets is clearly a part of terrestrial ecology and its advance may have been somewhat retarded initially by the fact that many investigators had little training in the type of field craft required. Things might have gone more smoothly if the study of Marbled Murrelets had been undertaken by people who had a background in owl research. Similarly, breeding biology studies of arctic-nesting jaegers would hardly differ in their techniques from those of other raptors.

The emphasis on oceanographic correlations in seabird habitat studies creates a fundamental division between marine and terrestrial ornithology (the term "terrestrial ornithology" is never invoked, because all ornithology is assumed to be terrestrial unless otherwise stated), but

places it close to marine biology. So why has marine ornithology not found a place as a branch of marine biology?

The answer to this question can be derived from Gaston's First Law: *ecologists don't look up the food chain, they only look down*. This is especially evident in the marine environment. Those who study phytoplankton are concerned mainly about water chemistry and temperature; those who study zooplankton are concerned about water chemistry and phytoplankton dynamics; those studying fish are interested in plankton, while those studying marine mammals are interested in the whole food chain. Everyone is interested in what is below their chosen organism, because they believe that food is an important limiting factor. No one is interested in the parts of the food chain above their organism, because no one thinks that predation has much effect. Seabirds, being at the top of most marine food chains, and having, by the standards of fish and invertebrates, minuscule standing stocks, are considered by marine biologists, if they consider them at all, to be epiphenomena. Like spume cast up by storms at sea, they are symptoms of great forces at work, but not themselves part of those forces.

So seabirds never received any attention from marine biologists, except as hobbies for people like Roger Pocklington and, as nature abhors a vacuum, it was left to ornithologists to extend their investigations to the marine environment. This is why, in Canada, seabirds are the responsibility of the Canadian Wildlife Service, while every other marine organism is looked after (in the sense of looking for them after they have gone) by the Department of Fisheries and Oceans.

Overwhelmingly, what sets seabirds apart from other birds is their participation in food chains not only separate from the vegetation associations that define the ecology of the land, but arranged in a manner that promotes entirely different strategies for finding and capturing food. It is not that food in the ocean is more patchy than in terrestrial environments: actually, it is probably less patchy on the scale of hundreds of kilometers, but the fact that patches are, by terrestrial standards, extremely ephemeral. If we except certain near-shore zones of tidally-induced upwellings (which themselves fluctuate on a tidal cycle), then most concentrations of food for seabirds probably vary over time scales of minutes to weeks, rather than the predictable annual fluctua-

tions that characterize most terrestrial associations. So the study of seabirds becomes a study of opportunism and above all travel: each individual bird needs to cover large distances. The issue of feeding territories, so important for many terrestrial birds, hardly ever arises for seabirds once they get away from shore.

Now we are coming to the core of what would constitute marine ornithology, were there to be such a science. The elements are scale, and mobility, but constrained by the need to return to land for breeding. This combination gives rise to coloniality, and this, in turn (if you are prepared to follow Philip Ashmole), has led to the many characteristic features of seabird demography and life history. Marine ornithologists must be concerned about oceanography and its effects in structuring marine communities, and with fisheries and their impacts on both target and non-target species. They need address foraging theory in the context of highly dynamic resources spread over areas unthinkable in studies of terrestrial birds and over time scales from minutes to centuries. They must consider demographic theory in a context where reproduction is highly variable and long-deferred, generations are hugely overlapping and senility is an important phenomenon. They must consider social behaviour in the context of the largest and densest reproductive aggregations found for any vertebrates. We should not say that terrestrial ornithologists view their ecology on a smaller scale, although most do. The essential thing is that the marine ornithologist has no choice but to consider whole oceans, because the events affecting seabirds are typically large-scale phenomena.

There are other attributes of seabirds that are fairly unique within ornithology, but shared by many aquatic vertebrates. For instance, underwater foraging may take place at very low light intensities and may require exceptional abilities in breathhold diving. These problems are shared with ducks, and aquatic mammals, reptiles and amphibians, and hence, although part of marine ornithology, do not constitute seabird-specific problems.

Where can we find parallels for the salient features of seabird biology among other organisms? Among birds, certain birds of prey, especially vultures, share many of the characteristics of seabirds: they are colonial breeders, do not hold feeding territories, and forage over large areas looking for concentrated sources of food: they are long-lived and rear few



young. If we look outside the class Aves, it is clear that the marine mammals, especially the seals, confront many of the same problems as seabirds and come up with some of the same answers. Some are colonial while breeding and some, though fewer, are central place foragers at that time. Some range over large areas of ocean looking for concentrated food. They do so more slowly than seabirds, but they can afford to do so because their energy reserves are much larger and their energy consumption per unit body mass much lower. But because they are mammals, and therefore viviparous, they have developed other strategies to cope with coloniality and its consequent local depletion of food. Their life-history adaptations are less extreme than seabirds: they do not live as long and they (mostly) start to breed at a younger age. In all these characteristics they resemble penguins, but not flighted seabirds. It is not surprising that those who, like Gerry Kooyman and John Croxall, study penguins, often study seals as well.

Cetaceans are even less like seabirds in their life-history adaptations than seals. Being able to give birth at sea frees the whales from the tyranny of colonies and central-place foraging and their huge size means that feeding can be highly discontinuous over time. Like seabirds, they are faced with the need to locate small, ephemeral food patches spread over vast areas. It could be that, if we make allowance for the difference in time scales, the foraging behaviour of whales and seabirds is very similar. The deployment of satellite telemetry, certain to be a huge growth-area for seabird and cetacean biologists over the next decade, should allow us to make that comparison very soon. However, the huge difference in reproductive strategies between whales and seabirds makes them very different in

other aspects of their biology. We have certain things in common with marine mammalogists (marine biologists don't care about whales either) and certain areas where our study organisms diverge substantially. A Society of Marine Homiothermologists is a possibility, and might have a lot to recommend it, but it may be rendered inoperative by the difficulty of pronouncing "homiothermology". A Pacific Seabird and Vulture group is even less likely, whatever the parallels in their foraging ecology.

Is there a science of marine ornithology? I can imagine those of you who go to sea in ships and count birds in different currents and water types nodding your heads. Yes, this is marine ornithology and we are the ones doing it. Surely all that seasickness should get some kind of reward? Well, maybe. The trouble is that the field pioneered by Roger Bailey, Dick Brown and company is really straightforward marine biology, simply applied to birds. The paradigms and methods are identical to those of any marine zoogeographer: go out and sample as many things as possible for as many bits of ocean as possible and look for correlations and concordances. Nothing wrong with that, but nothing unique enough to make a field of science out of it. Only when the distributions at sea are mapped onto the constraints of coloniality, when densities of birds can be adjusted by their travel times and calibrated against the rate of change in their prey patches, do we begin to create something that is unique to seabirds, and hence begin to create a separate marine ornithology.

Likewise, a demographic study of albatrosses which tells us that age at first breeding is adjusted in relation to expected lifetime reproductive success is a lovely result, but a straightforward application of population ecology. When the

age of first breeding can be scaled to foraging radius and to prey density, then we begin to approach a uniquely seabird science. Proving that Least Auklets prefer mates with plumes like those of Crested Auklets provides useful support for one theory of sexual selection, but is just another cog in the big machine that is behavioral ecology. If it can be linked to the enormous scale of coloniality among auklets then it begins to fall within the ambit of marine ornithology as a specialist discipline.

There is no special virtue in developing a unique science. Some people might argue that answering questions unique to seabirds is a waste of time, because by definition the application of the results can only apply to seabirds. But this could be said about studying any special adaptation. One of the good things about the mixture of traits that I have identified as being at the core of marine ornithology is that they require integration of information and ideas from a broad range of scientific disciplines. If we look at marine ornithology in a positive way, we can say that it is an interdisciplinary science looking at biological problems on a very large scale. And scale itself is a positive virtue, because, all too often, ecologists tend to study things at a scale that is far smaller than the scale on which natural populations and natural events actually occur. Seabirds, through their vast foraging ranges, force us to work and think on a large scale. This can be painful and frustrating, but it can be fun.

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## LOST AT SEA - ALMOST: MORE ON SEABIRDER MORTALITY

By *Michael Gochfeld*

Mark Rauzon's lead article (*Pacific Seabirds*, Fall 1997) was very evocative and brought back memories of near death experiences. Humans are supposed to learn from their mistakes. My first thought was of a long-forgotten line read as an adolescent about a seabirder "who lost his life in a fall from a California seabird cliff." It took a few minutes to find this reference to Ralph Hoffman, author

of *Birds of the Pacific States* (Peterson 1957, *The Bird Watcher's Anthology*, p.279). The article brought back vividly, a long-suppressed memory of my own experience. On a beautiful Sunday morning, when I, like Josh Nove, was 23, I found a lobsterman willing to take me out to a seabird rock off eastern Nova Scotia. Bringing his boat to within 200 yards of shore, he shuttled me in a dory,

and I scaled the cliff-face, aided by the dangling remains of an old dock.

I was intending to study the interactions between Great Black-backed Gulls and Puffins. But no sooner had I found a vantage point, than my chauffeur was back beckoning me to come down, because the wind had shifted and picked up (he used a Scottish term that I can't recall). Descending the cliff was harder and

took longer than climbing up. And as I lost my footing and clung precariously to the decaying timbers, 40 feet above the rocks, the epitaph "who lost his life in a fall from a seabird cliff", passed through my mind. I regained my footing and climbed down. He maneuvered the dory close to the rocks and as it rode up on a wave I jumped into the bow. But climbing up from the dory to the deck of the pitching lobster boat in the wind-tossed seas, proved to be an exhausting and dangerous challenge. Though we were more at risk of having our hands crushed between the boats rather than drowning, I have a very clear recollection of just how dangerous my seabird work could become (quite unlike the placid beaches of Long Island on which I later did much of my work). I suspected that drowning at sea en route to (or preferably from) a seabird colony, might well be the eventual means of my demise, and I found it paradoxically rather satisfying, compared to alternatives. The lobsterman, for his part, said he would never take anyone out to the islands again. Risking his boat for the mere \$18 he had charged me, wasn't worth it.

More dangerous, and equally unanticipated, was an experience Joanna Burger\* and I had while visiting tern colonies with

Kees Hulsman in the Capricorn Group on the Great Barrier Reef. Whenever possible we migrate to a tropical clime for New Years, and it was a delight to celebrate New Years on Masthead Island with Green Sea Turtles and Black-naped Terns. A few days later, while en route to Northwest Island, home of a million Wedge-tailed Shearwaters, a beautiful blue sky shifted suddenly to black, the island ahead of us disappeared, and our 6 meter long cabin cruiser was enveloped in a squall. Having learned the Beaufort scale on land with trees as a guide, I had no real clue as to the wind force, but our captain, estimated it at 100 kilometers per hour "easy", while he passed around the life jackets. Donning life jackets while gripping the roof of the cabin to avoid bouncing overboard, was no mean feat. Not until our African tent was surrounded by lions last summer, did I again experience the sense of panic and impending doom, that I felt being tossed violently up and down in that small boat. I calculated that we might be able to hold on for a few more minutes, before muscle fatigue caused us to lose our grip. The captain had all he could do to keep the bow into the wind; I have no doubt our survival rested on his skill. Later like crime wit-

nesses, we could not agree on how long we were at the mercy of that squall (at least 10 minutes, although some guessed 20). We surely could not have endured 30 minutes. As tropical calm returned it took hours for the adrenaline rush to subside.

In reading Mark's tribute to Josh Nove, I was reassured that there are sea dieties to "protect us most of the time"---certainly something must work in lieu of common sense. Ours probably doesn't rank as a really dangerous profession---not like a policeman or firefighter, or a commercial fisherman in Alaska, or perhaps even a school teacher in a crime-ridden city. But like these professions, we take our risks in stride. We pursue a career whose benefits are largely aesthetic and whose quarry increasingly needs our attention.

\*On reading this, Joanna remarked that being charged by a bull Moose at Agassize NWR (Minnesota) while studying Franklin's Gulls (yes they are a seabird most of the time), was her must panicky moment.

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# ARTICLES

## TECHNIQUES FOR MARBLED MURRELET AGE DETERMINATION IN THE FIELD

By Craig S. Strong

The use of hatch-year juvenile (HY) to after hatch-year (AHY) ratios of Marbled Murrelets (*Brachyramphus marmoratus*) counted at sea as an indicator of productivity is a recent technique (Anderson and Beissinger 1995, Ralph and Long 1995, Kuletz and Kendall 1998), born from the extreme difficulty in obtaining productivity data at their disperse, solitary nest sites high in older coastal forest trees. HY:AHY numeric ratios, or ratios of densities of HY:AHY at their respective periods of peak abundance, appear to work as indices of productivity, provided that a good representation of marine habitats is surveyed, and sample size is sufficiently large (Kuletz and Kendall 1998, Strong 1996).

Age ratios are obtained by sampling the number of murrelets in their first basic (juvenile) plumage and the number in alternate plumage or undergoing prebasic molt. Age determination is possible in the field only before AHY birds are in completely basic plumage. Carter and Stein (1995) provided a thorough description of HY and AHY Marbled Murrelet plumage and molt, and recommendations for discriminating age in the field. The use of molt class categories to quantify plumage status and track molt chronology was first described by Fix et al. (1995). My objective here is to clarify techniques for ageing Marbled Murrelets, and to describe the specific timing and features which results in confident age determinations during the period of advanced prebasic molt in AHY. These methods were developed in northern California and Oregon between 1994 and 1997; the chronology of molt progression may be slightly different in other regions or other large scale marine habitats, such as inland passageways of Washington and British Columbia, or Alaska.

Marbled Murrelets in alternate plumage are a dark, mottled brown, deserving of their common name. The prebasic molt of AHY Marbled Murrelets can begin as early as late June, but progresses slowly, so that few, if any, birds have completed molt by late August. Body molt along all feather tracts begins prior to wing molt, and is first apparent as a lightening in

color on the neck and breast areas. Primary molt starts with the inner primaries and progresses rapidly out, so that the birds are rendered flightless for some time prior to new primary growth. Basic and juvenile (first basic) plumage is easily distinguished from alternate plumage by the very dark wings and dorsal surface and white breast, abdomen, throat, and scapulars. The distal end of breast and belly feathers of HY birds are edged with dark brown. This edging is variable, and in some cases is not present or is reduced by feather wear after the fledglings have been at sea for some time. In cases of pronounced dark feather edging, the breast and belly color can appear an even light brown color, but never blotchy. Further details of plumage and molt chronology can be found in Carter and Stein (1995).

In 1994 I developed criteria to categorize the molt state of murrelets detected on transect as follows:

CLASS 1 (C1): Very little or no molt. Entirely in alternate plumage; bird appears chocolate brown.

CLASS 2 (C2): Obvious body molt but estimated at less than 50% of alternate plumage lost or replaced. Breast and neck obviously lighter than back.

CLASS 3 (C3): Over 50% of alternate plumage lost or replaced, but still clearly distinguishable from HY birds by brown alternate plumage feathers on back, breast, and belly. Molting birds were placed in class 3 if their throat and neck appeared whitish in overall color.

CLASS 4 (C4): Appears to be in basic plumage when seen from a distance. By definition class 4 birds were those that required close examination to verify age. This class included all HY as well as advanced-molt AHY birds.

Wing molt status is not generally apparent when birds are on the surface. When seen, wing molt is evident in a few C2 birds, most C3 birds, and all C4 AHY birds that are not in entirely basic plumage. The use of molt classes for quantitatively describing the molt sequence is an effective field technique that allows quick ageing of most Marbled Murrelets, and defines those requiring more attention.

Because this technique has been adopted by many observers conducting at-sea surveys, it is useful in comparing inter-annual and inter-regional differences in the chronology of prebasic molt (see Figure 1).

Prior to August, essentially all AHY birds are in the early stages of molt (C1-C3), and data on age of birds can be collected while on transect for density measurements; it is relatively easy to determine age of birds within 80 m while underway, although binoculars are recommended at over 30 m if there is back-lighting. Difficulty in age determination does not arise until AHY birds are in an advanced stage of prebasic molt (C4). The first C4 AHY birds were encountered between 1 and 4 August 1994-1996, and in the last week of July 1997. Murrelets in C4 plumage become common between 15 and 22 August and are in the great majority by the last week of August (Figure 1). To age C4 birds, the transect is halted and the birds are approached slowly to examine plumage and behavioral characteristics for age determination. Both (all) observers should examine each group until age is ascertained, until birds are lost, or until the time limit is reached (set at 10 minutes to avoid undue disturbance to the birds). Transects are interrupted with increasing frequency in August to age C4 murrelets, so separate density transects and ageing surveys may be desirable.

Determination of age as AHY among C4 birds is based on a) presence of brown alternate feathers on back or neck when viewed closely in good light, b) presence of alternate plumage feathers on the abdomen, which gives a dark or blotchy appearance, c) missing or growing flight feathers, or d) presence of alternate plumage feathers in the bill as a result of preening. Alternate plumage molt of the abdominal area is delayed relative to the rest of the body. Dark, alternate plumage feathers persistent on the abdomen after other body molt is complete are seen in photos of murrelet study skins (Carter and Stein 1995 Figures 1, 3). A good view of the 'dark belly' of a C4 murrelet, seen in the moment when the bird turns on its head to initiate a dive is the easiest means

## ARTICLES

of ageing as AHY when body plumage is otherwise basic. The usefulness of these criteria is date-dependent and changes through August. By late August, wing molt is the only reliable plumage criteria; we observed AHY birds with completely basic body plumage, but with their new outer primary feathers still growing in, so the wing appeared short or rounded when birds flapped.

Behavior of murrelets in C4 plumage provide both a clue to their age and an opportunity to observe salient features. AHY C4 murrelets appear reluctant to dive (we could often approach quite closely) and generally flap upon their surfacing following the first evasive dive (rarely did HY birds flap following their first dive). A slow initial vessel approach until birds dive, followed by pausing in neutral gear with ready binoculars for the initial surfacing, is an effective means of taking advantage of this behavior to view the abdomen and wings for signs of molt.

In 1996 it took an average of 84 seconds to age each group of AHY murrelets using this technique.

As might be expected of fledglings recently arrived to the sea, HY murrelets exhibit some different behaviors than AHY. When approached by a boat, HY birds often initiate a series of dives with an irregular course and very brief surface intervals, interpreted as a 'panic response' to an unfamiliar stimulus. When initially seen within a group, HY birds are readily separated from other murrelets by the approaching boat, and do not quickly rejoin other birds, as do members of paired AHY birds. Because of these behaviors, we were probably more likely to lose track of HY birds, particularly in sub-optimal observing conditions. In 1996 we averaged 178 seconds of observation to age birds as HY.

Observers should discuss and concur on all age determinations, and if plumages observed are inadequate to be certain of

age at the end of observations, the bird(s) are designated unconfirmed AHY (AU), unconfirmed HY (JU) or unknown age (U), based on what has been seen. The unconfirmed status birds should be delineated in age ratio analyses, so that a range of ratio values is presented, depending on their inclusion in the ratio.

Using the above methods, we aged 4,804, 4,354, and 2,201 murrelets between 19 July and 30 August of 1994, 1995, and 1996, respectively. Of C4 birds in this period, 80%, 92%, and 91% were aged (n= 507, 1095, and 302 for 1994, 1995 and 1996, respectively). Based on field descriptions of molt progression from the 1994-1997 seasons, the following dichotomous key was developed to illustrate the date-dependent nature of useful ageing criteria, and to serve as a guide for those learning the ageing techniques.

- 1a) Molt class 1-3 ..... AHY
- 1b) Molt class 4 (requires further examination) ..... 2
  
- 2a) 'Scruffy' plumage, no sharp line between nape and neck,  
rust colored feathers present ..... AHY
- 2b) Crisp black and white appearance ..... 3
  
- 3a) Date before 7/25 ..... HY
- 3b) Date after 7/25 ..... 4
  
- 4a) Egg tooth visible or fine, even flecking clearly  
seen on breast ..... HY
- 4b) Above features not seen ..... 5
  
- 5a) Dark or blotchy abdomen seen in good light when  
bird dives ..... AHY
- 5b) Abdomen and breast white or with fine fleck marks  
(rarely flecking is heavy, but always very even) ..... 5
  
- 6a) Date before 08/10 and bird not strongly paired ..... HY
- 6b) Date on or after 08/10 ..... 7
  
- 7a) Primary wing molt apparent as gaps in wing outline  
or short, new primaries ..... AHY
- 7b) Wing outline full when bird flaps ..... 8
  
- 8a) Date before 08/25 ..... HY
- 8b) Date after 08/25 ..... 9
  
- 9a) Bird strongly paired with another, maintain proximity  
throughout observation, vocalize if separated ..... AU
- 9b) Bird separates from group or is single. No  
vocalizations, makes many short evasive dives ..... JU

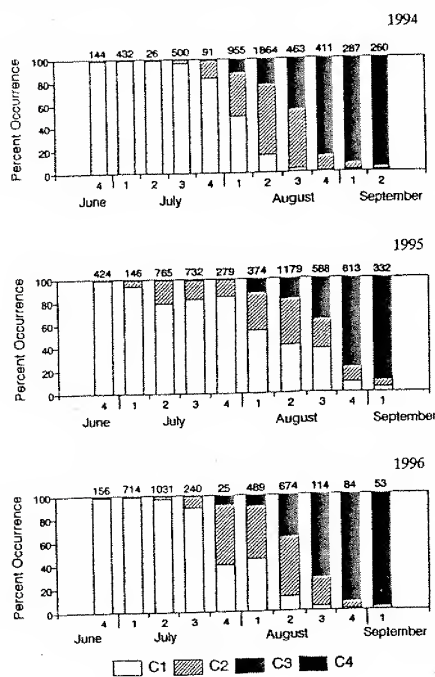


Figure 1. The proportion of Marbled Murrelets in 4 molt class categories during surveys from late June to September in 1994, 1995, and 1996, illustrating the progression of prebasic molt. Numbers at top of bars are sample sizes of birds classified in each week, numbers on x axis are the weeks in each month. See text for definitions of molt class categories.

A higher percentage of HY were unconfirmed than were AHY, largely due to the different behavior of the two age groups; HY were less likely to flap and show their wings, and more likely to be lost before age determination due to their erratic dives. By 1 September, there are some AHY birds in entirely basic plumage, so confidence in age determination necessarily drops. Because a proportion of HY fledge from nest sites in September (Hamer and Nelson 1995), and most birds can still be aged with certainty, it may be desirable to continue productivity surveys, depending on the objectives of the study,

and the level of uncertainty deemed tolerable. A very small proportion of the population are HY, however (Anderson and Beissinger 1995, Ralph and Long 1995, Strong 1995), so bias by mis-ageing even a few basic plumage AHY in September can result in erroneous age ratio data. In other words, surveys specifically for collecting age data in September are not advisable.

Use of these techniques results in efficient ageing of murrelets with a high degree of certainty until the last week of August. Practice is required to readily detect the briefly visible cues from which age can be determined late in the season, but even recent recruits to at-sea murrelet survey methods can become competent and confident at ageing with proper field training.

My thanks to the Oregon Dept. of Fish & Wildlife, the U.S. Fish & Wildlife Service, and the Marbled Murrelet Study Trust for research support, to Harry Carter and Janet Stein for their pioneering work on murrelet ageing in the field, and to the many astute observers who participated in field observations, in particular Mark Fisher, David Fix, and Jeff Jacobsen.

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[This is a peer-reviewed article.]



# ARTICLES

## HAUGLIN'S GULL IN NORTH AMERICA

By W.R.P. Bourne

When I commented on the possibility that Asiatic dark-backed gulls allied to *Larus (fuscus) heuglini* might occur in North America (Bourne 1994), a possibility subsequently also remarked upon by Wilosn (1996), I failed to notice that as since pointed out by Post and Lewis (1995) the form *taimyrensis*, currently treated by some Russians as a race of a distinct species, Heuglin's Gull *Larus heuglini*, had already been reported at Icy Cape, Alaska, on September 16, 1921 (Bailey 1948), and later listed as a Lesser Black-backed Gull *L. fuscus*, which Post thought needed re-examination. The Colorado and British Museums of Natural History have kindly arranged the loan of this specimen. It is a bird of the year in very fresh plumage, and nobody has many comparable skins. It is small for nominate *heuglini*, but comes exactly between extremely similar specimens of *L. f. graellsii* from England in the autumn and (slightly more worn) *taimyrensis* from Bombay Docks in the winter, a difference proportionate to their measurements in mm:

	Wing	Tail	Culmen	Adult Wing
<i>graellsii</i>	400	132	48	414 (395-433) n=15
Icy Cape	412	150	50	
<i>taimyrensis</i>	431	158	54	439 (410-471) n=31

In common with numerous distinguished predecessors quoted by Bailey (1948) I find it extremely difficult to decide which form it belongs to, and suspect this may also apply to most Lesser Blackbacks found west of the North American continental divide. The identification of this group of gulls is also causing problems in the Old World, recently discussed by Kennerley et al. (1995), Bourne (1996), and Garner (1997) among others, and it seems increasingly doubtful if it is useful to recognise so many separate species, and if so, to attempt to distinguish between them in the field.

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[This is a peer-reviewed article.]

# CONSERVATION NEWS

## MANAGEMENT OF NATIONAL WILDLIFE REFUGE SYSTEM

Congress enacted the National Wildlife Refuge System Improvement Act in 1997 to provide an organic act for the refuge system. Congress determined that the system's mission is to "administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of fish, wildlife and plant resources and their habitats."

This act allows the public new opportunities to shape the management of the national wildlife refuge system. Each refuge must be managed to fulfill the mission of the system and the specific purposes of that refuge. In administering the entire system, FWS must preserve the biological integrity, diversity, and environmental health of the system.

FWS is now implementing the act by developing new or revised policies. One of its first tasks is to revise the Service Manual chapters for the refuge system. The manual will guide management strategies for all wildlife refuges, including many important seabird colonies. FWS' Federal Register notice states that it will address the following issues in this process: Biological integrity of the refuge system; Appropriate general public uses for the system; Implementation of the compatibility test; and Comprehensive conservation planning.

FWS is soliciting public input and will make these draft chapters to available on its web site (<http://refuges.fws.gov>) beginning in May 1998. FWS must establish new compatibility policy and regulations by October 1999. PSG will provide comment on these issues, and individuals who wish to assist in this activity should contact Craig S. Harrison.

## FWS ALLOWS COMMERCIAL AQUACULTURALISTS TO TAKE CORMORANTS

The U.S. Fish and Wildlife Service has published a depredation order that allows commercial aquaculturalists to take double-crested cormorants that are preying on their fish stocks without first obtaining a permit under the Migratory Bird Treaty

Act. The order affects 13 states, primarily in the southeast and Texas. Director Jamie Rappaport Clark said FWS "is letting aquaculturalists take action to protect their livelihood when nonlethal methods are ineffective. This action will have no significant effect on the cormorant population but will provide needed relief on a site-specific basis." FWS declined to include non-cormorant species in the depredation order. The American Bird Conservancy vigorously opposed allowing the depredation order to include herons, egrets or other piscivorous species.

Double-crested cormorant populations are at an all-time high of 1-2 million birds, and have been increasing at an annual rate of 6-7%. The order is not intended to control the double-crested cormorant population, but to address site-specific problems in which cormorants are eating commercial species such as catfish. The greatest impact will be near the Mississippi Delta where catfish farmers lose 3-7% of their inventory each year to double-crested cormorants. Some farmers are hit particularly hard, while others are unaffected.

To take cormorants, a state wildlife agency must first certify that a cormorant depredation problem exists, that aquaculturalists have employed non-lethal techniques to control cormorant depredation, that non-lethal controls have not been effective, and that lethal control is warranted. Until FWS issued this order, aquaculturalists had to rely on either harassing the birds or putting net covers over their facilities to keep the birds out. These methods have often been ineffective or prohibitively expensive.

Aquaculturalists must maintain a monthly log of the number of cormorants taken. FWS will supplement these logs by phone and mail surveys. FWS will also review several other sources of data to monitor the effects of this order on the double-crested cormorant population.

## FWS AND NMFS PROMULGATE NO SURPRISES RULE

The Fish and Wildlife Service (FWS) and the National Marine Fisheries Service (NMFS) promulgated a rule that codifies the habitat conservation plan (HCP) as-

surances for permits issued under the federal Endangered Species Act (63 Federal Register 8859, February 23, 1998). Such assurances were first provided in 1994 through the "No Surprises" policy and are included in the Endangered Species Habitat Conservation Planning Handbook issued in December 1996.

Under the No Surprises policy, holders of an HCP incidental take permit are assured that FWS and NMFS will not require the commitment of additional land, property interests, or financial compensation for species covered by the permit. These assurances remain in place even if unforeseen circumstances arise as long as the permittee implements its commitments in the HCP. The rule was opposed by a wide variety of environmental organizations because nature is full of surprises.

The final rule clarifies that the assurances apply only to incidental take permits where the HCP is being properly implemented, and apply only with respect to species adequately covered by the conservation plan. It also emphasizes that assurances cannot be provided to federal agencies.

The preamble explains that FWS and NMFS believe that this rule is needed because there were inadequate incentives for non-federal landowners to conserve endangered species in their day-to-day management of land. The Services emphasized that before issuing a permit, they ensure that the applicant minimizes and mitigates the project impacts, and that the permitted activities avoid jeopardy to the continued existence of the affected species. In cases where significant data gaps exist, the Services will require adaptive management provisions in the HCP so that management practices must adapt to new information.

## AUSTRALIA LISTS TWO ALBATROSS SPECIES AS VULNERABLE

The Australian Minister for the Environment has determined that the Shy Albatross (*Thalassarche cauta*) and the Sooty Albatross (*Phoebastria fusca*) are vulnerable species under the Australian Endangered Species Act. The minister decided not to place the Black-browed

Albatross (*T. melanophrys*) on the list. In taking these actions, the minister accepted the recommendations of the Endangered Species Scientific Subcommittee. These evaluations were made considering new taxonomic research relating to albatrosses that increased the number of species of albatross in the world from 14 to 24 and a resulting re-evaluation of the conservation status of albatross species. The major reason for decline of these species is mortality associated with commercial fishing operations, particularly longlining.

## D.C. CIRCUIT REJECTS CONSTITUTIONAL CHALLENGE TO ESA

On December 5, 1997, a sharply divided panel of the federal D.C. Circuit Court of Appeals rejected a constitutional challenge to the Endangered Species Act (ESA) in *National Association of Homebuilders v. Babbitt*. At issue is the endangered Delhi Sands flower-loving fly which exists only in Southern California. It is not known to cross state lines during its life cycle, nor is there trade or commerce in this species.

The National Association of Home Builders, San Bernardino County and two California cities argued that the ESA's restrictions violate the Commerce Clause because taking the endangered fly would not affect interstate commerce. The Constitution allows Congress to regulate commerce among the states, which has enabled most of the federal environmental laws. The Supreme Court's 1995 ruling in *U.S. v. Lopez* questioned the extent of that power when it struck down the Gun-Free School Zones Act because of an insufficient link between gun possession near schools and interstate commerce.

In a rarity for this type of case, the panel wrote three opinions. Judge Wald's majority opinion upheld federal protection of the fly under Congress' power to regulate either channels of interstate commerce or activities substantially affecting such commerce. She found the federal protection of the fly affects interstate commerce because current and future interstate commerce can depend on the use of plants and animals in medical, pharmaceutical, and genetic research.

Judge Henderson's concurring opinion stated that "loss of biodiversity itself has a substantial effect on interstate commerce," even where it is impossible to know if any given species may have some

future medical, genetic, or economic value. In dissent, Judge Sentelle asked whether Congress could "regulate the killing of flies, which is not commerce, in Southern California, which is not interstate." He concluded Congress could not.

The National Association of Home Builders has asked the Supreme Court to review this case. While the Supreme Court takes a very small percentage of cases it is asked to review, the Court may take this case if it is interested in expanding its *Lopez* decision in an environmental context. If this challenge were successful, federal protection for about half of the 1,100 species listed under the ESA would be eliminated because they occur only within a single state. Such a ruling could affect federal protection of Newell's Shearwaters, California Brown Pelicans, and Hawaiian petrels.

## HISTORIC ANTARCTIC PROTECTION AGREEMENT IS LAW

With the ratification by Japan, the Environmental Protection Protocol to the Antarctic Treaty has now entered into force. The Protocol bans mining in Antarctica for 50 years and designates the whole continent and its dependent marine ecosystems a "natural reserve devoted to peace and science."

The 1959 Antarctic Treaty has kept Antarctica free from conflict, but human pressures on the continent's unique environment have been growing rapidly from increased numbers of scientific research stations and tourist ships. The Protocol also requires environmental impact assessments of all activities, and includes provisions on waste disposal, marine pollution, specially protected areas and the conservation of wildlife. A Committee on Environmental Protection will oversee its implementation.

Antarctica represents about ten percent of the earth's surface, and plays a central role in regulating the earth's weather patterns and ocean circulation systems. The surrounding seas support a wealth of penguins, albatrosses and other seabirds, seals, and whales. The pristine nature of the region provides unique opportunities for scientific research.

Japan's ratification was the last agreement needed from all 26 Antarctic Treaty member nations for the Protocol to become law. Negotiated in 1991, it has taken over six years for all the Treaty na-

tions to ratify the Protocol. The 26 member nations of the Antarctic Treaty are: Argentina, Australia, Belgium, Brazil, Chile, People's Republic of China, Ecuador, Finland, France, Germany, India, Italy, Japan, Republic of Korea, Netherlands, New Zealand, Norway, Peru, Poland, Russia, South Africa, Spain, Sweden, the United Kingdom, the United States, and Uruguay.

## REDUCING SEABIRD MORTALITY IN LONGLINE FISHERIES

Albatrosses and other seabirds are being killed in longline fisheries around the globe. Cost-effective avoidance techniques can be implemented to eliminate seabird deaths. Since ocean drift net fishing was banned by the United Nations General Assembly in 1992, longline fisheries have increased significantly. They deploy thousands of baited hooks that may extend 80 miles. While the fishermen set lines, seabirds dive on the bait and become impaled on the hooks.

In March 1997, the Committee on Fisheries (COFI) of the Food and Agriculture Organization (FAO) of the U.N. agreed to organize, in collaboration with Japan and the United States, an expert consultation on seabird bycatch in longline fisheries. It appointed a Seabird Technical Working Group to develop a plan of action and seabird avoidance guidelines to apply globally and to be adopted by the FAO.

The working group met in Tokyo in late March 1998 and included representatives from the U.S., Japan and the FAO. A panel of experts discussed the following background papers: the status of longline fisheries globally (written by Norway), seabird impact in longline fisheries (written by John Cooper, BirdLife International, South Africa) and avoidance techniques (written by Nigel Brothers, Australian Fish and Wildlife Agency, Tasmania). After reviewing the papers, the participants at the working group meeting developed a plan of action and recommended guidelines to avoid seabird bycatch in longline fisheries.

These recommendations will be brought to a November 1998 FAO consultation in Rome. If agreed to at the November meeting, the recommendations will be brought before the full meeting of the FAO/COFI in 1999. If adopted, the guidelines are to be implemented by all fishing nations.



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# PSG NEWS

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## PSG TREASURER POSITION OPENING - CANDIDATES NEEDED

PSG seeks nominations for the position of Treasurer, as Jan Hodder will not seek re-election in the fall elections. If you are interested in helping out PSG in this important and essential position please contact Pat Baird, of the Election Committee.

*Pat Baird*, Election Committee Coordinator. E-mail: patbaird@csulb.edu

## PACIFIC SEABIRDS EDITOR POSITION OPENING - STARTING 1999

The current editor of Pacific Seabirds is stepping aside after the next annual meeting, requiring the appointment of a new editor, beginning with the Spring 1999 issue of Pacific Seabirds. Preferably, candidates should be active in, and have knowledge of, the affairs of the Pacific Seabird Group, as the editor is a member of the Executive Council. Candidates should have knowledge of desktop publishing and offset printing. The editor of Pacific Seabirds is an appointed position.

*Steven M. Speich*, Editor. E-mail: sspeich@azstarnet.com

## NEW PSG OFFICERS ELECTED

The Candidates: 94 voting, 94 respondents.

Chair-Elect: Ed Murphy  
Secretary: Kathy Kuletz

Regional Representatives (with number of respondents who voted for Chair and number of respondents who voted for their representatives):

Alaska and Russia: 15 voting, 17 respondents Robert Suryanam is the new Regional Representative.

Northern California: 21 voting, 21 re-

spondents Craig Strong is the new Regional Rep (write in: Esther Burkett)

Pacific Rim: 4 voting, 4 respondents. Beth Flint is the new Regional Representative.

Old World: 2 voting, 2 respondents. Mark Tasker is the continuing Regional Representative.

## CALL FOR NOMINATIONS?

A call for nominations to be sent to me at Cal State would be good to put in. I have talked with the secretary about the mail problem and she promised that she would talk to all her student assistants to be more careful with disposition of mail.

Candidates for the following positions are needed: Chair; Treasurer; Vice-Chair Conservation; Southern California; Canada; Oregon Washington; Non-Pacific North America.

*Pat Baird*, Election Committee Coordinator. E-mail: patbaird@csulb.edu

## PSG MEMBER AND AWARD RECIPIENT MDF UDVARDY DECEASED

Dr. Mikos D.F. Udvardy, a longtime PSG member and recipient of PSG's Lifetime Achievement Award, passed away December 23, 1997, in his sleep, from complications following throat surgery. A memorial will be placed in the Fall 1998 issue of Pacific Seabirds.

## REPORT OF THE PSG SEA- BIRD MONITORING COM- MITTEE

The Seabird Monitoring Committee was established by order of the Executive Council in January 1992. The Committee's mission and mandate, previously published in the Bulletin (volume 19[2]:3-4), is to: (1) coordinate seabird monitoring by evaluating the adequacy and comparability of methods in use and making

recommendations as to species, sites, and population parameters to include in an overall Pacific monitoring program, (2) disseminate results by soliciting and compiling annual updates from ongoing population studies and incorporating them in a common database designed for trends analysis, (3) promote seabird monitoring among the appropriate authorities and agencies in participating countries, states, and provinces, and (4) foster geographically broad approaches to seabird monitoring by encouraging planned comparisons that enhance the role of seabirds as indicators of large-scale change in the Pacific marine environment.

Since fiscal year 1995, the Committee's chief project—the creation and maintenance of a comprehensive database for seabird monitoring results from throughout the North Pacific—has been funded by the USGS Biological Resources Division (formerly National Biological Service). Through an ongoing cooperative agreement between USGS and the PSG and a number of interagency agreements within the Department of the Interior, this funding has supported the input of seabird monitoring records and development of a PC-based tabular and spatial information system for managing the data. As of January 1998, the system included nearly 10,000 observations, each representing a measurement of a population parameter (e.g., numbers, productivity, chronology, survival, or other annual index) for a given species in a given location and year. These data comprise some 1,680 different time series and include information on 72 species from 192 locations in the North Pacific. Data from Alaska, British Columbia, Oregon, California, Hawaii, Japan, and Mexico are currently in the system. The longest time series incorporated to date is 25 years; the shortest are 1 year in length. Average series length is 6 years, and the earliest observations date from 1936. In 1997, we launched a concerted effort to gain full participation of seabird observers in Mexico through the efforts of Eduardo Palacios at the University of California at Davis.

During 1998, the Committee intends to release a "Beta test" version of the Pacific Seabird Monitoring Database to a select number of seabird observers and cooperators. This release will be for purposes of general review and error checking be-

fore the information is disseminated more widely. Ultimately, we envision distribution via an Internet web-site for access by registered users.

*Scott A. Hatch*, Seabird Monitoring Committee Coordinator

### PHOTOS AND ART WORK NEEDED FOR PSG WEB SITE

Photographs and art-work of seabirds, their habitat and field researchers are needed to illustrate the PSG web site. Prints, transparencies and flat art will be scanned and returned. Please contact Steve Speich (E-mail: [sspeich@azstarnet.com](mailto:sspeich@azstarnet.com)) if you have suit-

able items.

### MARINE RESOURCES INFORMATION FOR PSG WEB SITE

The locations of marine resource web sites on the world wide web are needed to enhance and expand the Marine Resources page of the PSG web site. The page is intended as a resource for information relative to marine birds and their environment. This can include, but is not limited to, information on climate, weather, oceanography, fisheries, news groups, etc. See the PSG web site for current links to pertinent web sites.

### PACIFIC SEABIRDS INDEX

A volunteer is needed to prepare an index to the first 25 years of Pacific Seabirds. At least articles, committee reports and forum pieces are to be included. The index will be used on the PSG web site to allow access to the back issues of Pacific Seabirds now being placed on the site. In addition, an index to all PSG abstracts is also needed.

*Steve Speich*, Publication Committee Coordinator (E-mail: [sspeich@azstarnet.com](mailto:sspeich@azstarnet.com))

## PACIFIC SEABIRD GROUP 1999 ANNUAL MEETING - BLAINE, WASHINGTON



TWENTY-SIXTH ANNUAL MEETING  
24-26 FEBRUARY 1999

The Twenty Sixth annual meeting of the Pacific Seabird Group will be held 24-26 February 1999, at The Inn at Semiahmoo, near Blaine, 18 miles north of Bellingham, Washington. Contact Lore Leschner at [leschl11@dfw.wa.gov](mailto:leschl11@dfw.wa.gov) of the local committee for additional information. Details will be posted on the PSG web site as arrangements for the meeting develop

**CONSULT THE PSG WEB SITE FOR THE MEETING TIME SCHEDULE, PAPER AND POSTER SESSIONS, COMMITTEE MEETINGS, SOCIAL EVENTS, AND PAPER ABSTRACTS**

# REGIONAL REPORTS

CANADA,  
September 1997  
By Tony Gaston

[This report was inadvertently omitted from the last issue of *Pacific Seabirds* - Editor.]

As in previous reports, I am allowing individuals to speak for themselves: your regional representative's contribution is merely some judicious editing (and what my own group is doing, of course).

## Arctic

**Grant Gilchrist** writes: A study of COMMON AND KING EIDERS, at EAST BAY, SOUTHAMPTON ISLAND, NORTHWEST TERRITORIES, in collaboration with **Mark Wayland**, CWS, and **Christine James**, Guelph Veterinary College, examines eider population dynamics and factors affecting eider reproduction and survival. Related topics of study include quantifying the impacts of avian and polar bear predation on eider reproduction (there was a lot this year, to some surprise and consternation - Ed.), quantifying the magnitude and effects of internal parasites on brooding ducks, quantifying the magnitude of imbedded shot and metal contaminants and their effects on adult survival, and comparing survival and reproductive parameters of King and Common eiders at the colony. In collaboration with **Dave Kay**, Ducks Unlimited Canada and **Nunavut Wildlife Research Trust**, Common Eiders were also surveyed on islands along the south coast of Baffin Island and in the Belcher Islands. Results of this program will establish estimates of the breeding population size of eiders in the area (perhaps as much as 16% of the *borealis* race), and identify key breeding, molting, and staging areas of eiders in the region. Traditional ecological knowledge garnered from local Inuit hunters regarding key habitat sites will also be evaluated.

A major oceanographic program in waters adjacent to Ellesmere and Devon islands is underway (THE NORTHWATER POLYNYA PROJECT). This project will examine seabird trophic relationships as part of a larger energy and contaminant flow investigation involving primary producers through highest trophic-level feed-

ers (seabirds, marine mammals). **Keith Hobson**, **Ian Stirling**, and **Ross Norstrom** (all CWS) are involved primarily in the carbon and contaminant flow-model. **Grant Gilchrist** (CWS), **Knud Falk** (Ornis Consult, Denmark), and **Kaj Kampp** (University of Copenhagen) are studying productivity, reproductive chronology, feeding rates, and diet of thick-billed murres and black legged kittiwakes by comparing colonies on the west and east margins of the polynya.

Studies of Thick-billed Murres at Coats Island went ahead as usual and involved (in addition to your regional rep), **Garry Donaldson** (Chelsea Creek Consulting), **Kerry Woo**, **Debbie Martin**, **Gabriella Ibarra** (Queen's University) and **Josiah Nakoolak**. Breeding in 1997 was the earliest recorded in 14 years. There is evidence of a significant trend towards earlier laying and a decrease in the proportion of arctic cod in the diet over the life of the project: events that make a strong contrast with what has been happening in Atlantic Canada (see below). The colony is expanding and numbers of prospectors were very high this year. Recent (1993) changes in hunting restrictions in Newfoundland may be showing results.

## Atlantic Canada

**Ian Jones** summarises work by his Memorial University of Newfoundland students at Gannet Islands, Labrador: This was the second year of operation. **Mark Hipfner** and **Rachel Bryant** continued their graduate research, joined by **Shauna Baillie** who has begun an MSc thesis on Atlantic Puffin foraging. **Monica Kidd** continued projects on Razorbills and Atlantic Puffin demography as chief technician, assisted by **Sherry-Lynn Rowe**, **Brian Veitch**, and **Alejandra Nunez de la Mora**. In contrast to 1996, capelin showed up in good numbers this year, with a notable improvement in seabird productivity. In Newfoundland, **Ed Hearne** completed field-work on his MSc study of tourboat disturbance in Witless Bay. Recommendations to provincial parks will be made based on his results. **Monica Kidd**, after returning from Labrador in early August, began capturing puffins at Gull Island, Witless Bay to set up a second marked population for comparative demographic work: over 100

adults individually colour banded so far. (last two projects joint with **John Chardine**).

**John Chardine** (Canadian Wildlife Service and Memorial University) writes: The annual meeting of the CAFF Circumpolar Seabird Working Group was held in St. John's, Newfoundland in April. It included a one-day technical paper session held jointly with Canadian Wildlife Service and Memorial University. Fieldwork in 1997 included continued monitoring of breeding success of Black-legged Kittiwake at several sites in Newfoundland. For the second year in a row, breeding success approached "normal" despite the fact that the relative timing of kittiwake breeding and capelin arrival were markedly different from 1996. The interaction of kittiwake and capelin timing and seasonal trends in breeding success are currently under study.

Research was initiated on the winter diet of murres off Newfoundland, and the age and species composition of hunt. Samples were obtained from about 600 birds collected in the 1996-97 hunting season. This will provide a comparison with work carried out a decade ago, prior to the groundfish crash of the late 1980s. Outside of Canada, completed the thirteenth year of work in a colony of Brown Noddies nesting near Culebra, Puerto Rico.

## Quebec

**Gilles Chapdelaine** writes: **Pierre Brousseau** and **Jocelyn Thibeault**, Canadian Wildlife Service (Quebec Region), worked at Corossol Island (Gulf of St. Lawrence) to assess productivity and feeding ecology on kittiwake, Herring Gull and Razorbill. Net productivity had been high for Razorbill (ca. 72%) and Herring Gull (>1 chick/pair) but not so good for Kittiwake (<1 chick/pair) because of high predation by Great Black-backed Gull. Chicks that were lost to gull predation exhibited a normal growth rate until the day of their demise, so foods appear to be plentiful. Hatching success was very good. Prey of kittiwake was mostly sand lance, some capelin, and a few invertebrates. Razorbills at Corossol fed almost exclusively on sand lance, whereas at St. Mary's both sand lance and capelin were important but capelin more in terms of weight. Herring Gulls fed



## REGIONAL REPORTS

mainly on capelin. Fulmars bred for the first time at Corossol Is. in 1996 and were present at Corossol Is. Again this year but apparently did not succeed to hatch the single egg.

**Jean-Francois Rail and Gilles Chapdelaine**, also with the Quebec Region of CWS, studied Double-crested Cormorants, Razorbills and Common Murres at St. Mary's Island (Lower North Shore). Breeding success was excellent for Razorbill (~72%), for murres and for Double-crested Cormorant (~2.1 chicks/pair; last year 2.6/pair). Main food of Common Murre was capelin but at the end of the season sculpins and sandlance appears in their diet. Capelin this year appeared bigger than usual. Razorbills fed on sandlance and capelin but capelin remains the most important in term of weight. Double-crested Cormorant continued to feed on schooling fish (sandlance and capelin) rather than benthic species: a change from earlier observations - a paper on diet changes for Double-crested Cormorant in the Gulf of St Lawrence has been submitted to Canadian Journal of Zoology. Survival rates of adult Razorbills appeared normal (~90%). The breeding season at both Corossol and St. Mary's islands was ~7-10 days later than normal for all species.

The small colonies of Common (100 pairs) and Arctic Tern (30-40 pairs) at St. Mary's Island did not breed this year, although birds were present. We visited other colonies of Arctic and Common Tern in the vicinity of St. Mary's Is. and came to the conclusion that at small colonies (< 150 pairs) birds did not breed or had very little success. When they did breed, it was very late (more than 15 days later than usual). At one large colony (< 1500 pairs) breeding was late and productivity probably low. Water and air temperatures were low this year: while alcids delayed their nesting season but breed successfully, terns did not breed or if they did had very little success.

Paralytic shellfish poisoning has been detected again in gannets and herring gulls in the southern part of the Gulf of St. Lawrence. There were recent reports from amateur ornithologist that many Gannets have very weird behavior, landing on gravel beaches, allowing close approach by humans and showing symptoms of nervous system disorders. Last year we had substantial mortalities of sandlance, Herring Gulls and some Gannet on the north shore of the Gaspe Peninsula, asso-

ciated with a spectacular "red tide" (bloom of the toxic dinoflagellate *Alexandrium tamarense*). According to Department of Fisheries and Oceans, red tide is occurring more and more frequently in the southern part of the gulf of St. Lawrence. Conditions for red tide are calm water during many days, heavy rain and rising temperature of water... With all the interest in climate change, I think it is worth keeping an eye open for consequences to seabirds.

### British Columbia

**Ken Morgan** (CWS, Sidney, BC) has had a busy year: (1) Pelagic Seabird Surveys Along Line P: a multi-year study, in collaboration with the Department of Fisheries and Oceans, to analyze the spatial and temporal variability in pelagic seabird species, abundance and distribution in relation to oceanographic characteristics (e.g., surface temp., salinity, nutrients, primary production, zooplankton) off the west coast of BC. Improved understanding of scales of variability will aid in the interpretation of results from colony studies (e.g., SFU Triangle Is. project), and will assist in evaluation of important marine areas. Four surveys along the same 1,500 km route were conducted to date (May 1996, August/September 1996, February 1997, June 1997). Highlights include: Mottled Petrels (February & June 1997), 1 Solander's Petrel (June 1997), Murphy's Petrels (February & June 1997), 1 Dark-rumped Petrel (August 1996), single Aleutian Terns (May 1996 & June 1997), 1 Xantus' Murrelet (September 1996), 1 Parakeet Auklet (February 1997) and Horned Puffins (May 1996, February & June 1997). As this may be the largest El Nino event of the century, I am hoping to continue the project for 2 more years, to evaluate the influence of the El Nino on the abundance and distribution of North Pacific pelagic seabirds; (2) Marine And Shoreline Birds Of Victoria And Esquimalt Harbours, a multi-year study (co-funded by the DFO, National Defence, BC Ministry of Environment, and the Capital Regional District) to monitor the number and distribution of coastal marine birds in order to assess the "value" of the harbours, and to identify candidate areas for enhanced levels of protection surveys, initiated in April 1997, are conducted primarily by volunteers every other month; and (3) North Pacific Marine Science Organization (PICES) - Working Group Member - Assessment Of Prey Consumed By Marine Birds And

Mammals Within Oceanographic Regions Of The North Pacific working group (with reps from Canada, US, Japan, Korea and Russia) co-chaired by Dr. George Hunt, Jr. and Dr. Hidehiro Kato task of working group is to derive estimates of: i) numbers of birds and mammals within North Pacific, by species, by oceanographic region, by season, and ii) the amount of prey consumed by species or group, within each area and season. To derive BC estimates, I summarized all CWS ship-of-opportunity pelagic survey data spanning 17 years and over 16,000 square km.

**Anne Harfenist**, Canadian Wildlife Service, Pacific and Yukon Region, sends the following: We completed the fourth year of a 5-year study of Cassin's Auklets at Frederick I. The results are not yet analyzed, but the timing and chick growth seemed similar to previous years at this colony. Food samples were collected throughout the season and have been sent for analysis. Ancient Murrelets departed in similar numbers to last year; the median date of fledging was the same as last year but the distribution was considerably more skewed. A BBC film crew spent a week filming murrelets for the closing sequence of one part of the David Attenborough series on, The Life of Birds. **Todd Golumbia** (Parks Canada) and I completed the third and last year of monitoring food and chick growth of Rhinoceros Auklets at S'gan Gwaii. Breeding was late this year; no obvious signs of poor food availability were noted.

1997 Seabird Research in the CWS/Simon Fraser University Wildlife Ecology Chair is summarised by **Doug Bertram and Gary Kaiser**: We ran two major seabird projects in 1997 concerning: 1) colonial seabirds on Triangle Island; and 2) the Marbled Murrelet. A total of 27 employees, students and volunteers participated. The colonial research team lead by John Ryder conducted demographic, physiological and behavioural studies on Cassin's Auklet, Rhinoceros Auklet, Tufted Puffin, and Common Murre on Triangle Island from 23 March to 26 August. In contrast to 1996, Cassin's Auklet reproductive performance was strong with high nestling peak and fledging weights. Intensive capture mark recapture (CMR) studies continued and over 150 Cassin's Auklet blood samples were collected for comparative blood physiology studies with the Marbled Murrelet program. Rhinoceros Auklet CMR studies continued but

## REGIONAL REPORTS

breeding performance was intermediate due to low hatching success and nestling fledging weights. Nonetheless, **Laura Jones** (a MSc student with **Doug Bertam** and **Tony Williams**) successfully completed several experiments that examined parental provisioning response to variation in nestling condition. Tufted Puffins experienced almost complete reproductive failure due to heavy chick mortality (<10% survival). Common Murre, however, performed well and had high fledging success (> 90%). Inter-colony comparative studies were continued in partnerships with CWS, the University of Victoria and Parks Canada on Cassin's Auklet (Frederick Island, in the Queen Charlotte Islands [QCI]) and Rhinoceros Auklet (Seabird Rocks [W of Barkley Sound], Anthony Island [S tip of Haida Gwaii]).

The Marbled Murrelet program was composed of 3 teams: 2 conducted capture programs at sea level (in Desolation Sound and northerly Green Inlet) and the third, conducted forest habitat and nesting studies in the Bunster Range (near Desolation Sound). After several years of disappointing capture rates, the project had a bumper year with nearly 400 captures. The Marbled Murrelet research team in Desolation Sound, led by **Lynn Lougheed**, added a new dimension to the program by successfully employing the "dip-net" technique (using small zodiacs and hand-held spotlights). This allowed

the field season to be lengthened and to capture birds away from the fixed mist-netting site. Dip netting captured 155 murrelets from May 13 to August 6. This number included 18 recaptures - 8 of which were banded in previous years, 28 juveniles, 3 birds with eggs, 7 non breeding birds, and one winter plumage bird. The floating mist net array, used in 5 previous years for CMR studies, yielded 227 breeding plumage adult birds from June 8 to August 1. That number included 55 recaptures, 39 of which were banded in previous years. The grand total of captured birds was 382. From those data, we are working on new criteria for distinguishing juvenile murrelets from adults as well as information on distribution at night. In addition to demographic studies from capture data we obtained: morphological measurements; blood samples for gender determination and hormone analysis (conducted by **Brett Vanderkist** an MSc student with **Tony Williams**); information on seasonal movements and distribution of individually colour marked, and radio tagged birds (conducted by **Cecilia Lougheed**, an MSc student with **D Bertram** and **Fred Cooke**) and; radar detections of birds traveling in the vicinity of the mist nets.

The Green Inlet team, lead by **Gary Kaiser** and **Mark Drever**, captured 121 birds with the dip net technique and 4 birds with floating mist nets from 15 June to 10 July. Morphometrics and blood

samples were obtained for comparative analyses with the Desolation Sound population. The forest crew, lead by **Sandra Webster**, monitored nests in the Bunster Range and reported 15 nests occupied, 6 nests visited (birds circling above the canopy), and 7 nests with no detected occupants. None of those nests fledged chicks. Three new trees with landing sites were discovered. Vegetation was characterized at all sites. We are planning to capture enough Marbled Murrelets in winter to get a recruitment value and possibly a local population estimate by recapturing some of our 1000+ banded birds.

Recently published in Canada and available from K. Morgan: e-mail [morgank@ios.bc.ca](mailto:morgank@ios.bc.ca): a) *The Ecology and Status of Marine and Shoreline Birds of the Queen Charlotte Island*. 1997. Vermeer, K. and K.H. Morgan (eds.). CWS Occasional Paper No. 93, 150 pages; b) *A Preliminary Identification of Processes and Problems Affecting Marine Birds in Coastal and Offshore Areas of British Columbia*. 1997. Burger, A.E., J.A. Booth, and K.H. Morgan. CWS Tech. Rept. Series No. 277, 111 pages.

By **Anthony J. Gaston**, Canadian Wildlife Service, National Wildlife Research Center, 100 Gamelin Boulevard, HULL, Quebec K1A 0H3, Canada. E-mail: [tony.gaston@ec.gc.ca](mailto:tony.gaston@ec.gc.ca)

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# BULLETIN BOARD

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## PHOTOGRAPHS NEEDED FOR THE SEABIRDS OF THE RUSSIAN FAR EAST

Dr. Yuri Artukhin, an ornithologist, at the Kamchatka Institute of Ecology, Russian Academy of Sciences, is preparing a photographic guide to the seabirds of The Russian Far East. He intends to show each species of the region in adult summer and winter plumage, and juvenile/immature plumage, as appropriate. This is the first Russian language photographic guide to the seabirds. The book will be published by the Kamchatka Fishery Protection Service, for the use of ornithologists, birders and observers on fishing vessels. The guide will be useful to obtaining new data on pelagic distribution and incidental mortality of seabirds in foreign and domestic fisheries in the Russian Far East.

He writes, "If you or your colleagues have any colour slides of these species and if you are interested in placing your slides in the guide I would be very pleased to see them. If you cannot help, then do you know someone else who may

be able to help me? Let me know [if] you need more information. I hope that you will be interested in my [project] and will be able to help me." [He provided a species list that Pacific Seabirds will forward when requested.]

"Thank you very much in advance and look forward to hearing from you at your earliest convenience."

Dr. Yuri Artukhin, Kamchatka Institute of Ecology and Nature Management, Russian Academy of Sciences Laboratory of Ornithology, Rybakov pr., 19-a Petropavlovsk-Kamchatsky 683024 Russia. E-mail: [nick@marmam.kamchatka.su](mailto:nick@marmam.kamchatka.su) (for Yu.Artukhin)

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## DISCUSSION ON SEABIRD BY-CATCH BY LONGLINE FISHERIES DURBAN, SOUTH AFRICA AUGUST 1998

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John Cooper and Graham Robertson will convene a round table discussion on seabird bycatch at the 22nd International Ornithological Congress in Durban, South Africa, during August 1998. Longline

fisheries cause the deaths of thousands of seabirds annually, which become caught on baited hooks during setting and subsequently drown. Procellariiform seabirds are most at risk, especially the albatrosses and some petrel species. No global review is as yet available on the longline fisheries of the world and the species and numbers of seabirds that they catch. Mitigation measures have been developed in several fisheries and are being adapted for use elsewhere.

The discussion will address the following questions:

1. What are the global distributions and sizes (numbers of hooks set) of the world's longline fisheries and what numbers of birds of which species are killed annually?
2. What regulations control these fisheries and what mitigation measures are in use?
3. What mitigation measures might reduce bird bycatch as much as possible?
4. What mitigation measures should be developed and tested?

For more information, contact John Cooper, Cape Town, South Africa at [jcooper@botzoo.uct.ac.za](mailto:jcooper@botzoo.uct.ac.za)



# REPORT OF THE SECRETARY – 1998

## SUMMARY OF PROPOSED MINUTES OF THE PACIFIC SEABIRD GROUP EXECUTIVE COUNCIL MEETING

(Note: The full text of the Proposed minutes (recorded by Vivian Mendenhall) is available from the current Secretary (Kathy Kuletz). The Minutes will become official when they are approved at the 1999 Executive Council meeting.)

By *Kathy Kuletz and Vivian Mendenhall*

The Council met on 21 and 24 January 1998 at the Monterey Conference Center, Monterey, California. Sixteen members attended: Pat Baird, Alan Burger, David Duffy, Bill Everett, Tony Gaston, Craig Harrison, Jan Hodder, Scott Johnston, Kathy Kuletz, Roy Lowe, Jim Lovvorn, Elizabeth McLaren (with Deborah Jaques as proxy for the last half of the meeting), Vivian Mendenhall, Kim Nelson, Steve Speich, and Mark Tasker. Chair Kim Nelson continued the use of Robert's Rules of Order to facilitate meeting objectives. Reports of officers and committees were provided by e-mail or in Pacific Seabirds and were discussed only briefly at the meeting.

The minutes of the January 1997 meeting were approved, with the deletion of a motion in the Budget section that had not been fully recorded.

## REPORTS OF OFFICERS AND COMMITTEES

**RESTORATION:** Ken Warheit (substituting for its coordinator) reported that the change of chairs has led to lack of coordination; this will be addressed.

**PUBLICATIONS:** Steve Speich initiated discussion on whether PSG should publish on the World Wide Web. While this effort is being implemented, other members believe we still need to publish hard copies, as people in some countries have limited access to the Internet. Members discussed where various PSG publications are currently "archived", and whether the current informal distribution of publications is adequate. Currently, Pacific Seabirds is at the Western Foundation for Vertebrate Zoology, S. Speich has copies

of other publications in print, and various libraries hold out-of-print publications.

**SEABIRD MONITORING:** Scott Hatch reported that the monitoring database is funded for 5 years by USGS-BRD and is now in its 4th year.

## OLD BUSINESS

**FUTURE MEETINGS:** The Bylaws state that the Chair-elect will provide candidate locations for the next meeting, but because of the workload of that position, alternatives were discussed. One alternative would be to assign this task to the Past Chair. No motions on this were recorded. Other discussion centered around the need to plan meeting sites years in advance, to ensure availability and time to consider alternatives when problems arise. Nelson and others volunteered to investigate potential sites and bring proposals to the next Executive Council meeting.

On 21 January, the Committee voted to authorize Rosario (San Juan Islands) as the 1999 site, but because of the expense, Julia Parrish was investigating alternatives. The vote for Rosario was rescinded on 24 January and the coast of Washington, in general, was authorized as the 1999 meeting site. [Since then, the Committee has established, via E-mail, that Semiahmoo will be the meeting site - See meeting announcement.]

**FINANCIAL MATTERS:** The Treasurer's report for 1998 was adopted. Jan Hodder reported that she had filed delinquent Federal tax returns back to 1993. She is still working on state returns for California, and may need to file in Oregon because she, as treasurer, lives there.

No future contracts are planned at present, but PSG has an outstanding contract with the Exxon Valdez Oil Spill Trustees to produce a book from the Restoration Workshop. There has been no progress on the book, and the EVOS Trustees could withdraw funds. Members discussed the issue of overhead charges on contracts, with no decision reached. The PSG application for a Packard Foundation grant was rejected, but we were invited to resubmit the proposal under new guidelines.

**ENDOWMENT FUND:** A motion was approved that proceeds from the 1998 meeting (from auction and raffle) be put in the Endowment Fund. Members discussed the possibilities of diversifying the Fund's investments further, and asking the Endowment Fund Trustees for a report on the investment rationale; no decision was reached.

A motion was approved to submit an amendment to the Bylaws regarding the Endowment Fund. In brief, the amendments state that the Fund shall be used to support PSG publications and will be managed by three Trustees from PSG, one of which will be the Treasurer. The Trustees will report annually to the Executive Council and actual expenditures will be by recommendation of the Publications Committee and majority vote of the Executive Council. All monies from life memberships, donations, and other sources will go to the Fund. Details on the amendment can be obtained from the Secretary.

**PSG HANDBOOK:** Kim Nelson passed out drafts of the administrative handbook for PSG officers and asked for review and additions.

## NEW BUSINESS

**COMMITTEES:** The Council voted to abolish the following defunct committees: Seabird Sanctuaries, Seabird/Fisheries Interactions, Human Disturbance to Seabirds, Scientific Translations, and Mexico. The Council also voted to require committee heads to submit a brief list of expected accomplishments for the coming year at each annual Executive Council meeting. The Chair requested that committee heads review their committee mandates during the coming year, or if none exist, to write them. Mark Tasker was assigned to propose a "sunset rule" for committees that are not assumed to be permanent. Bill Everest read a new mandate for the Xantus' Murrelet Technical Committee, which was approved by the Council.

**EXECUTIVE COUNCIL PROCEDURES:** Some members have requested that they vote for Regional Representative where they do research, as opposed to where they live. The Council agreed to

## REPORT OF THE SECRETARY

leave the vote for Representatives as it currently is stated in the Bylaws, and members must vote where they live. Because of low voter response in the PSG elections, a motion was made to entice voters by including a raffle ticket with ballots. The motion failed after discussion, wherein it was agreed that if people don't know or care enough to vote, their votes will not contribute to PSG.

The Executive Council sometimes needs to vote between Annual Meetings, and a discussion ensued about alternatives. According to California nonprofit law, the Council can call special meetings by giving advance notice to members (4 days by mail or 48 hours by telephone), and can vote by mail or conference call. Our Bylaws say that notice of special meetings must be given 30 days in advance. A motion was approved to submit a Bylaws amendment to PSG members that would allow PSG to adopt California laws on notification for special meetings.

The Council rescinded a previous 1995 vote that authorized six elected PSG officers to enter into contractual agreements, proposals, endorsements or applications if a full Council vote could not be made in a timely manner. Vivian Mendenhall stated that PSG never used the procedure, it might not be legal, and the Bylaw amendment approved this meeting should solve the problem. A motion was approved to designate the local committee

chair and the next chair-elect to enter into contracts for arranging the next Annual Meeting on behalf of PSG.

**AWARDS:** A motion was approved that awards be given to the best student paper or poster, but not to "runner-ups".

**PACIFIC SEABIRDS:** Steve reported that Regional Representatives will be asked to submit regional reports according to a specified format. Beth Flint was designated as the first Regional Reports Editor.

**SNAIL & EMAIL:** The Secretary was assigned to handle all correspondence sent to our Seattle post office box. All future mail will be forwarded to the Secretary. The Secretary was assigned to establish a database of member's Email addresses to facilitate general electronic mailings. The exact use of an Email database was not clearly defined, and Council members had differing opinions as to its applicability. Within the Executive Council, limited mailings should include sending copies to all interested parties, such as PSG members involved in an issue.

**MEMBERSHIP IN OTHER GROUPS:** The Council voted to apply for membership in the Ornithological Societies of North America. The North American Banding Council has invited PSG to join their organization. During discussion, it

was pointed out that PSG belongs to multiple action groups already, and the existing member groups in NABC are more active than PSG in issues related to banding. The Council voted to decline the NABC invitation.

**PSG VISION & FUTURE EFFORTS:** A motion was passed to continue the Vision Group's efforts to develop the PSG mission statement. The Council also voted to create a working group to review the status and populations of seabirds throughout the Pacific. The group would draw up a tentative list of priority actions for research and conservation, with special reference to information gaps. A motion passed that the Chair initiate contacts with other marine organizations, other regional ornithological groups, the British and French Antarctic Surveys, and others to promote better communication about research and conservation on seabirds.

**1998 MEETING:** The local committee reported that 276 people registered for the 1998 Annual Meeting in Monterey, California. Proceeds from the sale of publications were approved for the Endowment Fund. The Council commended the Local Committee for a successful meeting. A motion was also approved to commend bill Everett for his excellent and tireless work for PSG over the past 4 years.

# ABSTRACTS

## ABSTRACTS OF PAPERS AND POSTERS PRESENTED AT THE 25<sup>TH</sup> ANNUAL PSG MEETING MONTEREY, CALIFORNIA, JANUARY 1998

Prepared by Alan E. Burger

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\* Person presenting the paper or poster indicated with an asterisk

### USE OF DIMETHYL SULFIDE IN FORAGING BY ANTARCTIC SEABIRDS

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Procellariiform seabirds are known for their remarkable sense of smell, but little is known about how these birds use naturally-occurring biogenic aromatics for foraging. In controlled experiments performed at sea, we recently found that several species of Antarctic procellariiforms were attracted to dimethyl sulfide (DMS; Nevitt et al., 1995). However, whether these birds associate at sea with naturally high levels of DMS has not been explored. From 20 March-5 May 1993, we concurrently counted procellariiform seabirds and measured ambient levels of atmospheric and seawater DMS levels as part of a NOAA RITS cruise. Of twenty-eight procellariiform species present in the survey area, blue petrels (*Halobaena caerulea*) and prions (*Pachyptila* sp.) were significantly more abundant in areas of high atmospheric DMS concentrations (8.1-12.5 pM/l;  $P < 0.05$ ). A significant relationship was not observed between the abundance of procellariiform seabirds and ambient seawater DMS concentrations. Wilson's storm-petrels (*Oceanites oceanicus*) and black-bellied storm-petrels (*Fre-*

*getta tropica*) were not associated with elevated atmospheric or seawater DMS concentrations, although these species were highly attracted to DMS in experimental trials. We will examine our findings in terms of known foraging strategies.

### CLIMATE CHANGE AND SEABIRDS: A REVIEW OF TRENDS IN THE EASTERN PORTION OF THE PACIFIC BASIN

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The distribution, abundance and natural history of Pacific Basin seabirds are sensitive to long-term variation in the atmospheric and oceanographic features that define their habitats. Effects can be direct, such as air temperature increasing stress or energy demands, or indirect, as with water temperatures affecting the distribution and abundance of prey species. While seabirds are constantly responding to modifications in their environment, only recently has the temporal extent of seabird studies and an apparent increased rate of global warming allowed examination of contemporary changes. We present case histories demonstrating the influence of recent climate change on seabirds in the Pacific Basin and adjacent Antarctic and Arctic. In several cases, clear changes are evident. Those at high latitudes are frequently tied to atmospheric changes affecting ice and snow habitats while those at middle and lower latitude are caused by oceanographic shifts. ENSO appears to have facilitated many changes in population size and range, with change coming in a step-wise fashion with each ENSO event. Some changes may be the result of the ending of the little ice age in the latter part of the last century.

### MARINE BIRD ECOTOXICOLOGY FOR THE NEXT CENTURY: PERSISTING PROBLEMS AND DEVELOPING TRENDS

#### OPING TRENDS

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The field of Ecotoxicology is barely 50 years old. Seabirds were among the first wildlife to show adverse effects from widespread environmental contaminants, and concerns during the 1950s-1970s centered on population health. The scientific approach was reactive: studying and remediating problems after they had occurred. Today, many depressed populations of seabirds (with abundant terrestrial examples, as well) have essentially recovered. But in some situations, problems persist because of: (1) continued, uncontrollable inputs and continued persistences of old, recalcitrant contaminants, (2) new data on unforeseen effects involving pollutant/physiological interactions (such as immunosuppressions, hormone disruptions, and contaminant reactions with secondary ecological stressors), (3) ever-increasing development and transport of hazardous materials and their associated accidents, and (4) the continued introductions of new chemicals. Ironically, one of the longest-standing issues, oil pollution, will carry strongly into the next century. New, potential contaminants may come to represent repeats in the lessons supposedly learned from this century. Yet, concerns for seabirds in contaminant situations must still center on the health of populations; and a predictive approach in Ecotoxicology will be necessary, where potential problems are defined before they occur.

### DIET COMPOSITION, REPRODUCTIVE ENERGETICS, AND PRODUCTIVITY OF SEABIRDS IN THE EXXON VALDEZ OIL SPILL AREA

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Reproduction in seabirds is frequently



limited by the parents' ability to allocate energy to the breeding effort. We examined potential energetic factors (diet composition, diet quality, meal size, meal delivery rate) that constrain the productivity of seabirds in the Exxon Valdez Oil Spill area. Lipid contents of fishes varied considerably, resulting in energy densities ranging from 2.0 to 10.8 kJ/g wet mass. Seabirds can potentially experience a five-fold difference in energy intake, based on the type of forage fish consumed. Pigeon Guillemots provisioned their young with both nearshore demersal and schooling forage fishes, while Black-legged Kittiwakes fed nestlings mostly herring, sand lance, and capelin. Higher energy density, larger meal size, and higher delivery rate resulted in higher energy provisioning rates to seabird broods, which influenced productivity. Growth performance of guillemot nestlings at Kachemak Bay declined coincidentally with less sand lance in the diet, whereas kittiwake growth performance was lower with less herring, sand lance, and capelin. This suggests that increased incidence of high quality of prey in the diet appeared to have a significant influence on seabird growth performance and productivity in Alaska.

#### DIE-OFF AND STARVATION OF SHORT-TAILED SHEARWATERS (*Puffinus tenuirostris*) IN RELATION TO PREY AVAILABILITY IN THE EASTERN BERING SEA

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Large numbers (thousands) of dead seabirds, particularly Short-tailed Shearwaters, were reported floating and washed ashore in the eastern Bering Sea during July and August 1997. In our study of the foraging ecology of Short-tailed Shearwaters during their annual migration to the Bering Sea, we recorded stomach contents and measured the total body mass, lipid content, and pectoral muscle mass of individuals collected prior to (June) and during (late Aug / early Sept) the die-off. In June, specimens contained significantly greater body mass, lipid, and muscle content than birds collected in Aug/Sept. Furthermore, Short-tailed Shearwater diet differed between the two

seasons. In June, it consisted almost exclusively of adult euphausiids, *Thysanoessa raschii*. In Aug/Sep, we observed a more diverse diet including juvenile *T. raschii* and *T. inermis* euphausiids, fish paste, and crab zoea and megalops. Most likely, shearwater starvation and mortality were caused by decreased availability of preferred prey. Anomalous physical conditions in the eastern Bering Sea during Summer 1997 were characterized by relaxed winds, decreased mixing along the inner front, and elevated sea surface temperatures. These unusual conditions probably initiated a cascade of perturbations in the food web which decreased the availability of adult euphausiids to shearwaters foraging in nearshore surface waters. This perturbation provided a unique opportunity to study how oceanographic variability disrupts ecosystem structure, and how the disruption of lower trophic levels ultimately affects apex predators such as the Short-tailed Shearwater

#### DETERMINATION OF PREY OF COLONIAL BIRDS: THE CALIFORNIA LEAST TERN AS AN EXAMPLE

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California Least Terns foraging in and around San Diego Bay, California, consumed mainly bay anchovies and topsmelt of 3-6 cm in length. We determined diet visually, verifying species type and size by fecal analysis. During the beginning of El Niño, the terns switched to sardines and northern anchovies of the same size. We collected dropped fish on the breeding colony and found that the species type as well as the size differed significantly from what the terns actually consumed. Other seabirds such as gulls and other terns regularly flew over the colony, and we suggest that dropped fish were from these birds instead. Thus, using dropped fish as a means to identify what certain species are eating can lead to erroneous results and should not be used.

#### SEABIRDS AT SEA: LESSONS FROM THE PAST, PREDICTIONS FOR THE FUTURE

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Although historically, the vast majority

of seabird research has focused on that portion of a seabird's life spent on land, the past twenty-five years have been witness to a tremendous increase in efforts devoted to understanding what seabirds do at sea. These efforts have been aided by methodological developments, including increased ability to identify seabirds at sea, due in large part to publication of comprehensive field guides, development of quantitative survey techniques in conjunction with greater numbers of pelagic research cruises, and vast improvements in computer capabilities and statistical methods allowing for quantitative treatment of multiple variables. We are now constructing complete distribution patterns for the world's seabirds and beginning to understand them in terms of habitat correlations and ecological interactions. We are documenting myriad ways that seabirds use to locate and procure prey, investigating their roles in the communities of which they are a part, and integrating these patterns into ecological theory. Finally, we are realizing that the ocean is not the pristine system, immune to anthropogenic effects, as was once thought. Even seabirds in the most remote oceanic regions are subject to a wide array of human-induced disturbances.

#### DISTRIBUTION OF SEABIRDS IN MONTEREY BAY DURING THE UPWELLING AND OCEANIC SEASONS OF 1996 AND 1997

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Recent studies of seabirds have demonstrated the importance of collecting simultaneous environmental and oceanographic data to interpret patterns of distribution and abundance. Monterey Bay is a highly productive ecosystem and supports a diverse array of migrant and post-breeding seabirds during the upwelling and oceanic seasons (May - November). Documentation of seabird distribution patterns within the bay was conducted via 13 shipboard surveys during the upwelling and oceanic seasons of 1996 and 1997. Strip transects of 100m width were surveyed in a random-systematic manner along east-west lines running offshore from the 30 fathom isobath, and spaced every three minutes of latitude. Thirty-three species of seabirds were documented, with Sooty Shearwater (*Puffinus griseus*), Common Murre (*Uria aalge*),

and Western Gull (*Larus occidentalis*) most common. Seabird groups differentiated themselves along bathymetric and sea surface temperature gradients. The most pronounced patterns were the occurrence of Common Murre throughout the bay when sea surface temperatures were low and over shallow neritic water as temperatures increased, Cassin's Auklet (*Ptychoramphus aleuticus*) over areas of deep water or steep bathymetry when sea surface temperatures were low, and Pink-footed Shearwater (*Puffinus creatopus*) when sea surface temperatures were elevated.

#### MONITORING BEACHCAST SEABIRDS IN MONTEREY BAY

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In May 1997, a monitoring study of beachcast birds and mammals was established in the Monterey Bay region. During weekly and monthly surveys, trained volunteers systematically searched 47km of sandy beaches along Monterey Bay. The primary goal was to assess trends in the distribution and abundance of beachcast seabirds, and assist the Monterey Bay Sanctuary program with early detection of mortality events caused by natural and anthropogenic perturbations. Secondary objectives of the program were to determine the appropriate sampling frequency for beachcast monitoring, and assess the effects of time-of-day and tidal cycles on deposition rates. During the first six months of the program, the most common beachcast seabirds were Common Murre (*Uria aalge*) and Sooty Shearwater (*Puffinus griseus*). Two significant deposition events occurred: greater than 400 Common Murres were deposited along beaches in the southern half of the bay during late August (cause undetermined), and greater than 400 birds were impacted by a spill event in the northern half of the bay in October. Although designed largely to identify long-term patterns, this monitoring study has demonstrated its usefulness in resource management over a short six-month period.

#### CONSISTENT PATTERNS OF INTERYEAR AND INTER-COLONY VARIATION IN RHINOCEROS AUKLET NESTLING DEVELOP-

#### MENT AND DIET ACROSS OCEANOGRAPHIC DOMAINS

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Interyear variation in developmental patterns of alcid nestlings coupled with nestling diet information can signal variation in prey availability over large spatial scales. From 1995-1997 we investigated Rhinoceros Auklet nestling development and diet at three colonies in British Columbia: Seabird Rocks (off Southwest Vancouver Island) in the coastal upwelling domain, and Triangle Island (off northern Vancouver Island) and Sgan Gwaii (off southern Haida Gwaii/Queen Charlotte Islands) both in the coastal transition oceanographic domain. In all years nestlings of a given wing length were heavier on the most southerly and northerly colonies, Seabird Rocks and Sgan Gwaii, than on the intermediate Triangle Island. Furthermore, on all colonies, nestlings of a given wing length were heavier in 1995 than in other years. Rapid nestling development and large meal size both between years and colonies were associated with high proportions of Pacific sand lance in the nestling diet. We explore mechanistic explanations for the observed large-scale patterns and emphasize the important role for behavioural studies to further understand the response of seabird parents to variation in prey availability and abundance.

#### USE OF TRANSMITTERS IN SIMULATED EGGS AND CHICKS TO MONITOR PREDATION OF ARTIFICIAL MARBLED MURRELET NESTS

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From 1995 to 1997 we placed 512 artificial Marbled Murrelet nests in 49 forested stands on the Olympic Peninsula. We tested the adequacy of artificial nests, using transmitters within simulated chicks and eggs, in detecting nest predation. Each nest contained either a plastic egg or

a mounted chicken chick with a movement-sensitive transmitter. We painted eggs to simulate Marbled Murrelet eggs, and dipped transmitters in wax. Transmitters served two purposes: they allowed remote sensing of predation-date (pulse-rate changed after disturbance), and allowed tracking of eggs and chicks that were carried by predators. Wax coating allowed identification of predators at 261 (64 %) of 410 preyed-upon nests. The use of both eggs and chicks allowed detection of a wide range of visual- and scent-oriented predators. Artificial nests were effective at investigating relative predation rates. We advocate the use of wax, transmitters, eggs and chicks, and feel it is important to compliment this work with research on potential predators identified at artificial nests.

#### CONTAMINANTS IN CANADIAN ARCTIC SEABIRDS

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Organochlorine levels in eggs of Thick-billed Murres and Black-legged Kittiwakes breeding in the Canadian Arctic have been monitored since the mid-1970s. During 1993, eggs and chicks of Thick-billed Murres, Black Guillemots, Northern Fulmars, Black-legged Kittiwakes and Glaucous Gulls were collected from several colonies throughout the Canadian Arctic including one site sampled since the mid-1970s. Species were chosen to represent a variety of trophic levels and feeding habitats. Egg contents and chick carcasses were analyzed for organochlorines including PCB congeners, as well as mercury, selenium, cadmium and lead. The highest residue levels of organochlorines were found in Glaucous Gulls. Geographical differences in residue levels were found between high and low Arctic Thick-billed Murres, and high and western Arctic Glaucous Gulls. Differing overwintering areas and feeding habits may explain some of the differences found. Comparisons of residue burdens in the eggs with chick body burdens indicates that all species were picking up cadmium, mercury and selenium from food in the local environment. Comparison of 1993 egg residue data with data from the mid-1970s and mid-1980s from the same colony shows that PCB and DDE levels have decreased in Thick-



billed Murres and Black-legged Kittiwakes.

**NATAL PHILOPATRY AND GENETIC STRUCTURE IN BREEDING POPULATIONS OF HARLEQUIN DUCKS (*Histrionicus histrionicus*)**

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Sex bias in natal philopatry should influence expected relatedness among individuals and genetic structure of breeding populations. Members of the philopatric sex should be more related to one another than members of the dispersing sex. Moreover, spatial proximity of related individuals may promote the development of dynasties in which related individuals associate socially, and which may in turn influence survival and reproductive success of group members. Although Harlequin Ducks of both sexes are reported as showing approximately 50% adult philopatry to breeding streams, no male natal philopatry has been reported, whereas female philopatry is confirmed in several areas. Using variation at microsatellite loci of Harlequin Ducks captured on breeding streams in 1996 and 1997, we assessed patterns of relatedness within breeding subpopulations in the Pacific population. By comparing these patterns within and between sexes, we evaluated the extent of sex bias in natal philopatry. This study provides insight into factors influencing population genetic structure, as well as information that may influence decisions on management of breeding populations.

**VARIATIONS IN COMMON AND THICK-BILLED MURRE CHICK DIET IN RELATION TO CHANGING PREY AVAILABILITY AT THE GANNET ISLANDS, LABRADOR**

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The past decade has witnessed drastic changes in the abundance and distribution of many fishes common in the diets of seabirds breeding in Eastern Canada. Capelin, which historically predominated Common Murre chick diet at the Gannet Islands, Labrador, virtually ceased spawning on Labrador beaches during the early 1990s. Fifteen years after previous researchers studied Common and Thick-billed Murre chick diet at the Gannet Islands, we revisited the islands to assess changes in murre productivity, feeding rates, chick diet composition and diet quality (as measured by energy density and fat content of prey). During the early 1980's, capelin accounted for approximately 75% by number of Common and 25% of Thick-billed Murre chick diet (Birkhead and Nettleship, 1987). In 1996 capelin comprised only 15% and 2% of the chicks' diets. Concomitant with a slight increase in capelin abundance in southern Labrador in 1997, capelin comprised nearly 50% of Common and 5% of Thick-billed Murre chick diet. The relative paucity of capelin in the murres' diets in the 1990's accompanied an increase in diet overlap: both murres primarily fed their chicks daubed shannies. Despite interyear differences in diet composition, murre productivity, feeding rates and diet quality remained unchanged.

**BEHAVIOUR OF INDIVIDUAL BIRDS AT SEA: A REVIEW OF THE LA GRANGIAN APPROACH TO SEABIRD FORAGING ECOLOGY**

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We review the foraging ecology and time-energy budgets of birds at sea, focusing on the behaviour of individual birds rather than populations or communities. The past 25 years have produced massive advances in theory, technology, and empirical knowledge, but many aspects of the lives of birds at sea remain poorly known. The reliable use of seabirds to monitor ocean environments remains the holy grail. Advances in theory

(e.g., central place foraging, provisioning concepts, variable time buffers) and technology (e.g., activity data-loggers, radio- and satellite telemetry, time-depth recorders, and doubly-labelled water) have allowed greater understanding of the constraints of time and energy on breeding seabirds. The ecology of non-breeding seabirds remains a daunting challenge. Research on underwater foraging has begun to answer important questions on the abilities and limitations of diving birds, in a productive blend of conceptual modelling, physiology, remote-sensing technology and field ecology. Recent technology has revealed prodigious feats of flight and diving in many seabirds. We take a global view in reviewing concepts and technology, but focus on North Pacific species for advances in empirical knowledge.

**DIVING BEHAVIOR OF RADIO-TAGGED MARBLED MURRELETS IN CENTRAL CALIFORNIA**

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Concurrent with a radio telemetry study in central California, dive times were collected for Marbled Murrelets from May to July 1997. Dive times (n=789) and surface recovery times (n=763) were recorded for 44 diving bouts of 16 murrelets. Mean dive time was 24.8±12.2 (SD) seconds, (1-59 range); mean surface time was 14.1±9.7 (SD) seconds, (1-88 range). Dives were recorded between 05:29 and 21:12; the longest dives occurred during midday. Twelve complete diving bouts were recorded from three birds. Mean bout length was 18.1±3.9 (SD) minutes, (9-24 range). Mean number of dives per bout was 26±16.1 (SD), (11-58 range). Mean dive and surface times are comparable to previous results in the literature. In conjunction with other data on radio-marked murrelets, diving data allow a better understanding of daily for-



aging patterns in central California.

# MOVEMENT PATTERNS AND HABITAT PREFERENCES OF MARBLED MURRELETS IN CENTRAL CALIFORNIA: A RADIO TELEMETRY STUDY

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Telemetry studies of Marbled Murrelets have been hampered by the difficulty of capturing birds and finding nest sites, and by short duration of tracking ability. Our study utilized capture and attachment techniques which have proven successful for Xantus' Murrelets. We studied movements, at-sea habitats, and nest sites from May-September 1997. Forty-one murrelets were captured (28 radio-marked) in 7 nights of effort from May-August in Año Nuevo Bay. Sex ratio from blood samples was 16 females:25 males. In May-June, 81% of the birds had brood patches (n=26). Four inland nest sites were located in old-growth forests. Identified predators were peregrine falcon and red-shouldered hawk. Two murrelets exhibited long range movements of 181 km south, and 224 km north of Año Nuevo Bay. We tracked radio-marked birds for a mean of 47 days. Health and genetic makeup will be assessed through blood analysis.

# TRENDS IN POPULATIONS OF MURRES AT BREEDING COLONIES IN ALASKA

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Populations of Common and Thick-billed Murres have been monitored at a number of breeding colonies in Alaska since the mid-1970s. Time-series began earlier than the mid-1970s at a few colonies. We analyzed trends at all colonies with at least 5 counts in the past 25 years

to evaluate geographic patterns of change. It appears declines occurred prior to the mid-1980s at several colonies in the northern and southeastern Bering Sea, but numbers have remained stable or increased at these sites since that time. In the western Aleutians, murre numbers have increased since the mid-1970s, but have remained relatively stable in the past 5 years. No overall trends have been detected at colonies in the Gulf of Alaska, outside the trajectory of oil from the T/V Exxon Valdez oil spill. At colonies in the spill zone, such as the Barren Islands, numbers of murres recently appear to be starting to increase following the spill.

# TWENTIETH CENTURY OIL SPILLS AND COMMON MURRE MORTALITY IN CENTRAL CALIFORNIA

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Oil pollution has impacted the central California population of Common Murres throughout the twentieth century. Extensive oil mortality in 1917-1925 contributed to population decline along with commercial eggging and human occupation of colonies. The 1937 Frank H. Buck oil spill killed thousands of murres from the already severely-depleted population. The 1971 San Francisco oil spill killed 900-3,000 birds from a larger population that had been increasing since the late 1950s. From 1971-1986, assessments of murre mortality and population status improved substantially from efforts by Point Reyes Bird Observatory, Ecological Consulting, International Bird Rescue Research Center, and University of California. The 1984 Puerto Rican and 1986 Apex Houston oil spills killed about 1,500-2,000 and 6,300 murres, respectively. Oil mortality contributed to population decline from 1982-1989 along with gillnetting and El Niño. From 1985-present, efforts by several state and federal agencies have greatly enhanced continuing efforts to document the effects of oil pollution on Common Murres.

# MULTI-SCALE INVENTORY AND RESEARCH TO CONSERVE MARBLED MURRELETS IN CLAYOQUOT SOUND, BRITISH COLUMBIA

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Clayoquot Sound on Vancouver Island, an area of high-profile forest conflicts, supports one of the largest breeding concentrations of the threatened Marbled Murrelets in North America. Research on murrelets began in 1995 in response to recommendations from the government's Scientific Panel on forest management "to ensure that particular species known or suspected to be at risk are monitored and their habitats protected." Our goal was to quantify the importance of the Sound, and habitats within the Sound, for Marbled Murrelets, at a full range of spatial scales over multiple years. At the regional level, boat surveys estimated marine densities and distribution of the murrelets, to compare with other regions and track population trends. At the watershed level, we used radar to count murrelets entering each watershed and correlated these numbers with large-scale vegetation and topographic parameters. At the stand level we conducted standard audio-visual surveys to determine occupancy and to compare detection frequencies with macro and micro-habitat parameters. Detection data combined with ecosystem classification were used to rank and map habitats of importance to Marbled Murrelets. The results are being applied in delineating protected habitat and management zones in Clayoquot Sound, and other coastal areas of British Columbia.

# FEEDING RATES AND FOOD HABITS IN A SUCCESSFUL MARBLED MURRELET NEST IN WASHINGTON

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Little is known about the feeding habits and chick provisioning of breeding Marbled Murrelets. Most of the available information has been obtained from the Gulf of Alaska and British Columbia, with little understood about food habits in the southern portion of its range. During the 1997 breeding season, a video camera was mounted at an active murrelet nest, during the nestling stage, at Ruby Beach, Washington, located on the Olympic Peninsula. Activity at the nest was recorded from 21 July until fledging on 3 August. Time lapse and real-time recordings were both utilized in 8mm and VHS formats. These recordings, still undergoing analysis, provide information on the frequency of feedings, prey type, and size class of food delivered to the chick. Image quality affects the ability to identify prey to the species level. More information on food habits is needed to help in the conservation of the murrelet and marine resources.

# MARBLED MURRELET STUDIES AT DESOLATION SOUND, BRITISH COLUMBIA

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This overview will put in perspective the other presentations at this conference on the long term population study of Marbled Murrelets, which is being carried out at in the Desolation Sound area on the mainland coastal area of British Columbia. After an exploratory period of three years, a long term analysis of the population of Marbled Murrelets began in 1994. The aim was to catch and individually mark birds during the breeding period as an additional tool in understanding both population dynamics and reproductive performance of the species. We coupled this with a detailed nesting area study in the nearby Bunster Hills, in order to get a more complete picture of the requirements of the species during the breeding season. Almost 800 birds have been caught and banded since the start of the project, using mist-net and more recently dip-net catching techniques. The recapture of more than 90 of these birds allows us to calculate local survival rates. For the first time this year we were able to catch and mark juveniles soon after their arrival in the inlets. Birds were sexed using a DNA technique which enabled us to identify

possible sexual differences in behaviour patterns and distributions. One banded bird was recaptured more than a year later c.200 km from the banding site, and yet again at the original banding site in the following summer. This is the first record to our knowledge of the distant recovery of a banded Marbled Murrelet. Sixty-two nests have been found during the study, mainly by observations in the breeding season and by post-season tree climbing.

# EVALUATING THE MARBLED MURRELET SURVEY PROTOCOL WITH RADAR

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We compared concurrent radar and audio-visual observations during 37 mornings in 1997 to help evaluate the Marbled Murrelet forest survey protocol. Each morning, radar data were collected on all murrelet targets that passed over the area surrounding an audio-visual observer, who transmitted their information on murrelet detections to the radar lab in real time, using radio. For each observation, we determined whether radar, audio-visual observer, or both had detected the murrelet. Preliminary information suggests that 16% of murrelet movements in and out of nesting stands occur before official survey start time (i.e., prior to 45 min before sunrise). Because of the dark conditions and because apparently the birds that flew in early were silent, a very small proportion (<2%) of these "early" birds were detected by the audio-visual observer. For the entire morning, preliminary data suggest that over half of all murrelets were missed by audio-visual observers. The proportion of birds that were double-counted by audio-visual observers was low (3%). Murrelets can be detected by audio-visual observers at distances up to 700 m, depending upon local topography and background noise levels. We discuss the implications of our results for interpreting data collected using the standard survey protocol.

# USE OF RADAR AS AN INVENTORY AND MONITORING TOOL FOR MARBLED MURRELETS IN WASHINGTON AND OREGON

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Concurrent radar and audio-visual ob-

servations of Marbled Murrelets were made in 4 drainages in the Olympic Peninsula and in 16 drainages along the Oregon coast during 1996 and 1997. The reliability of distinguishing murrelets from other species on the radar was high, but we caution that radar observations should be accompanied by visual observations to verify species identification at all new sampling locations. A consistent peak in landward movements into nesting areas occurred ~30-60 min before sunrise, followed by a seaward exodus that ended ~1 h after sunrise. Radar counts of murrelets increased steadily during the summer, with mean counts nearly tripling between May and July, then dropping to low levels in August. Day-to-day variation in radar counts in May through July was lower for counts of landward targets (Mean CV = 32% and 10%) than for seaward targets (46% and 15%) in Washington and Oregon, respectively. Based on this range of variation, it would take 6 years (if CV was 10%) to 18 years (if CV was 46%) to detect a 10% annual change in numbers with 90% confidence and a = 0.05. We discuss the implications of our results for designing a murrelet population monitoring strategy.

# PROVISIONING RATE VARIABILITY IN TUFTED PUFFINS

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Provisioning rate of Tufted Puffins at Triangle Island, British Columbia, Canada were studied by analyzing mass increments of the chicks. Mass changes measured three times during the day (SUM) were an estimate of burrow food loads. Twenty-four hour mass increments (NET) were used to estimate the number of burrow loads per day. Half of the chicks were supplementary fed after daily mass was measured to discover if adults adjusted their burrow food loads. Chicks were harnessed or burrows were screened to collect burrow food loads. These were used to compare with the mass incremented estimate, as well as to identify what the Tufted Puffins were feeding their chicks.

# BREEDING PERFORMANCE OF BLACK-LEGGED KITTIWAKES IN



# RELATION TO FOOD AVAILABILITY: A CONTROLLED FEEDING EXPERIMENT

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To determine if food availability is responsible for the chronic breeding failure of Black-Legged Kittiwakes on Middleton Island, AK, we supplementally fed non-captive adults and nestlings herring *ad libitum* in 1996 and 1997 at a large artificial breeding colony on an abandoned radar tower. By manipulating food supply we addressed three questions: is food limiting their productivity, at what stages of the breeding season are the effects of food limitation most evident, and which parameters of breeding performance are most sensitive to food supply? The tower provided a uniquely accessible colony for experimentation allowing 144 nest sites to be installed with sliding, one-way glass windows and feeding tubes permitting us to closely monitor a series of breeding parameters in treatment and control pairs. Treatment groups were designed to contrast the three identified stages of breeding (prelaying, incubation, chick-rearing). Productivity of pairs supplementally fed through chick rearing exceeded both the control pairs and other treatment groups in both years. This study indicates that kittiwakes are most sensitive to food limitations prior to chick hatching. Further investigation into adult survival will allow an examination of the costs of reproduction in food stressed versus unstressed parents.

# USE OF SATELLITE TELEMETRY TO LOCATE KING EIDER FALL-STAGING AND MOLTING AREAS

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Satellite transmitters were implanted in eight male and two female King Eiders captured between 19 - 22 June 1997, on their nesting grounds on Victoria Island, NWT. They were subsequently relocated by satellite every three days. The males left the nesting grounds by 2 July, spent most of July off Baillie Islands and Banks Island in the eastern Beaufort Sea, spent several days in early August off Icy

Cape, and arrived on their molting grounds in mid August. The females started migration in mid August, each stopping for a few days at Baillie Islands and Icy Cape and arriving on their molting grounds in the first half of September. Of the nine eiders with functioning transmitters, only one remained in the Chukchi Sea to molt. The rest molted in the Bering Sea, widely distributed along the Russian coast from Mechigmen Bay south to the base of Kamchatka Peninsula, and in Bristol Bay off Alaska. Aerial surveys conducted on 29 September and 3 October in the vicinity of each of the two implanted birds in Bristol Bay, produced conservative estimates totalling 13,469 King Eiders.

# SOURCES OF RECRUITS DURING COLONY GROWTH: WHY THE MODELS GOT IT WRONG

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The relative contribution of locals and immigrants to colony growth is important to the development of both metapopulation theory and damage assessment and restoration. Two hypothetical models of colony growth for a nest-site limited seabird have been published. Both assume immigration is highest during rapid growth and stops completely when local production is sufficient to account for the observed rate of growth. I studied colony growth at a Black Guillemot colony where all fledglings have been banded since 1975. The relative contribution of local birds and immigrants to annual recruitment was monitored from 1978 to the present. Immigrants comprised 92% of recruits during rapid colony growth decreasing only slightly (to 87%) during a period of slight or no growth. In a period of colony decline, immigrants comprised 60% of all recruits. My findings indicate that the hypothetical models made a number of unwarranted assumptions about dispersal processes that resulted in underestimating the importance of immigrants. These included assuming that: 1) all local birds recruit at the natal colony when nests sites are not limiting, 2) local birds have a recruitment advantage over potential immigrants, 3) potential immigrants are only attracted to a colony when there is a surplus of nest sites.

# IS COLONY PHILOPATRY IN SEABIRDS BEING OVERESTIMATED?

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Fidelity to the natal colony is generally assumed to be high in seabirds. Researchers typically obtain estimates of colony philopatry by banding fledglings at one location and monitoring their return and recruitment. Colony philopatry is the percentage of the estimated number of fledglings surviving to breeding that recruit at the natal colony. Philopatry rates obtained in this way are typically assumed to be innate. Almost no studies of colony philopatry attempt to examine alternative regional recruitment opportunities or the effects of conditions at the natal colony. Without such information it is impossible to separate regional from colony philopatry. Because colonies chosen for banding studies are frequently the largest in a region, observed colony philopatry can be expected to be high even if recruitment is random within a much larger area. Accurate assessment of the spatial extent of philopatry is needed both for assessing the benefits of philopatry and developing credible damage assessment and restoration plans. The relative importance of regional and natal recruitment opportunities to colony philopatry in the Black Guillemot will be discussed. Published information on colony philopatry will be reconsidered in a regional context.

# FISH-HOLDING BEHAVIOUR IN MARBLED MURRELETS: AN ESTIMATE OF BREEDING POPULATION SIZE?

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Observations of Marbled Murrelets holding fish in their beaks may be strong indicators of birds about to depart to feed young, and thus may serve as measures of the proportion of individuals with nestlings in a population. Using boat surveys, we investigated how fish-holding in Marbled Murrelets in Theodosia Inlet, British Columbia, changed with time of day and group size during mid-July to early August, 1996. The proportion of murrelets holding fish fluctuated between 0-15 % between 0500 to 1659 h, then rose sharply to 30 % (SE = 4 %) between 1700 and 2100 h. We also found marginally significant evidence that single murrelets holding fish were seen more frequently on the water than pairs or in groups ( 3. Does



this reflect the true proportion of murrelets with nestlings near Theodosia Inlet? We discuss how observations of Marbled Murrelets holding fish may overestimate or underestimate this important demographic parameter.

## ECOLOGY AND ERADICATION OF NORWAY RATS ON LANGARA ISLAND, QUEEN CHARLOTTE ISLANDS

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Introduced Norway rats contributed to the decline of Ancient Murrelets breeding on Langara Island (3,200 ha), British Columbia. Using funds from the litigation settlement of the Nestucca oil spill, Environment Canada eradicated Norway rats from Langara Island and its associated islands. Work crews placed an individually-marked plastic bait station at every 75-100 m on a grid over the entire island (1 station/ ha). Bait stations were loaded with wax baits containing 50-ppm brodifacoum, an anticoagulant poison, and monitored every 48 h. Missing baits were replaced to maintain a constant number of baits per station. Rats removed bait for 26 days, after which crews placed baits in plastic bags in each bait station. These were left and monitored for 2 years, after which bait stations and remaining bait were removed from the island. The eradication appears to have succeeded. Rats were not trapped over ~ 400 trap-nights after poison campaign. Feeding activity by rats was not found on apples or oil-dipped chew sticks. Rats were detected around the lighthouse and fishing lodges in January 1996, but since then have not been detected. Measures must be taken to prevent reintroduction of rats to Langara Island.

## SYMPOSIUM INTRODUCTION: TWENTY FIVE YEARS OF SEABIRD STUDIES

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This symposium is designed both to look back over the advances in the study of seabirds during the last 25 years and to set a course for the next 25 years. Where has the study of seabirds moved forward; where has it lagged. What are the prospects for the future? The papers are de-

signed both as reviews and as efforts to convey the excitement of each field. If the symposium is successful, it should serve not just as a summary of where we have been, but as an agenda and an invitation to students, to a new generation, to make the next quarter-century as productive and exciting as this one.

## AFTERWORDS: SEEING THE SEABIRDS FOR THE SEA

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The last 25 years have seen extensive advances in seabird biology; however, this progress has been variable. Some fields of seabird biology remain essentially data-driven and descriptive. In extreme cases, these subfields have ignored revolutions in paradigms developed for other organisms. At the other extreme, other seabird fields have adopted theories even before there were many seabird data. Theory has then focused research and driven the use of new methods to test theories. Finally, as in the case of genetics, new methodology has rescued what had become a languishing field. In the future, technology will probably provide an excess of data. Internet communications will make these data universally available. Seabird biology may become more like physics and oceanography: the data are abundant, but good questions are scarce. To ask good questions, we need to pilfer theory from other fields, no matter how distant, as well as to develop a theory of seabirds: asking "what are the underlying generalities about seabirds and their responses to their environment of land, sea and air?" We have made a good start, but the best may be yet to come.

## DIET IN A GULL HYBRID ZONE: ARE YOU WHAT (OR WHERE) YOU EAT?

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Unlike other hybrid zones in which diet has been studied, there is very little difference in morphology among individuals in the Western Gull/Glaucous-winged Gull hybrid zone. Instead, ecological and behavioral factors may lead to differences in diet among pairs within the hybrid

zone. In this study, I: 1. tested for differences in diet based on variation among nesting habitats and reproductive stages and; 2. compared diet of gulls in the hybrid zone to that of the parental species in allopatry. Within the hybrid zone, percent occurrence of the four major prey types differed among habitats. Occurrence of fish increased from incubation to post-hatching for all pairs. Diet composition between pure Western Gull and hybrid pairs did not differ. Diet variation likely resulted from different disturbance regimes among nesting habitats. The percent of pelagic foods taken by gulls in Grays Harbor was greater than that of most Glaucous-winged colonies and less than that of all Western Gull colonies, making diet of gulls in Grays Harbor intermediate.

## APPLICATION OF MATHEMATICAL AND COMPUTER MODELS TO SEABIRD ECOLOGY: A STATUS REPORT

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The application of mathematical and computer modelling to seabird ecology is concentrated in three major areas: (1) foraging behavior, (2) energetics, and (3) populations. Our understanding of the distribution and availability of prey resources has increased greatly, and this is reflected in models of habitat selection and foraging behavior. This new information needs to be better integrated into the traditional central place/optimal foraging paradigm to take into account the variable and patchy distribution of prey. Energetics modelling benefits from improving information on metabolism and energetic costs, although the basic modelling techniques have not changed appreciably for some time. Population modelling has evolved significantly in recent years, taking into account interacting sub-populations as well as environmental stochasticity. Population models are limited by the availability of long term data and the difficulties of quantifying linkages between environmental variables and demographic responses. Models of seabird biology are increasingly used to address conservation questions, including oil spill effects, population stability, and the environmental causes of population declines. The greatest promise for future work lies in the increased availability of

## ABSTRACTS

computer time, computer expertise, and software. To best utilize these advances, modelers should try to make their computer programs available to other interested researchers.

### INTERSEXUAL VARIATION OF PARENTAL CARE IN CRESTED AUKLETS AT BULDIR ISLAND, ALASKA

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Crested Auklets are a monogamous, sexually monomorphic species with biparental care, with sexual differences in parental roles during chick rearing. In 1996 we began using radio telemetry to investigate patterns of parental attendance during the chick rearing period. In 1997 we tagged eight pairs, including two males captured during the incubation period. We examined male and female feeding rates and attendance on a weekly basis throughout chick rearing. Females fed chicks at higher rates during the first two weeks after hatching. We also examined crevice attendance (min/day) and found that males were spending almost twice as much time at the crevice compared to their mates during the first two weeks. Taken together, these results confirm that male and female Crested Auklets provide different types of parental care during the first half of chick rearing; females putting more effort into providing food for the chick, while males guard and brood. In 1997, pairs spent more time at the crevice than what we observed in 1996, which may indicate that food was more readily available in 1997.

### CONTRIBUTIONS OF MOLECULAR GENETICS TO UNDERSTANDING SEABIRD ECOLOGY AND EVOLUTION

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Since the biological characteristics of a species are products of its history, understanding a species' evolution is central to understanding its ecology. Initial progress in studies of seabird evolution was slow due to methodological limitations: estimates of gene flow depended on band returns, which are difficult to obtain; the only genetic markers available for study were a few morphological polymor-

phisms; and the fossil record was notoriously poor. However, recent molecular developments are enabling major advances in the study of seabird evolution. Firstly, they can yield direct insights into such aspects of seabird ecology as parentage and the demographic structure of colonies. Secondly, they can reveal mechanisms of evolution by enabling measurements of evolutionary forces. Thirdly, they can provide accurate reconstructions of evolutionary relationships, which can then be used in comparative studies. And fourthly, they can contribute to seabird conservation. Research in all of these areas is challenging many traditional ideas. For example, monogamy may not be as widespread as previously thought, gene flow among colonies may be extensive, and individual colonies may not be the appropriate units for conservation. Many potential applications of molecular genetics to seabird ecology and evolution remain unexplored, and possibilities for future studies are virtually unlimited.

### POPULATION DYNAMICS AND LIFE-HISTORY STRATEGY RESEARCH ON SEABIRDS

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With high adult survival rates, deferred breeding and low reproductive rates, seabirds look like the ultimate K-selected species. However, classical life-history theory, invoking stable or ephemeral habitats, does not fit seabirds well. Instead, foraging range seems the most promising factor to explain the demographic characteristics of seabirds. Created by Lack and Ashmole, the foraging range theory of seabird life-histories was developed, and mainly accepted, on the basis of inter-species comparisons, especially between pelagic (long-lived and laying a single egg) and nearshore species (lower adult survival and laying multi-egg clutches). The main exceptions to inshore/offshore generalizations are the penguins, which carry greater food loads than flighted birds; the precocial murrelets, which do not feed their young in the nest; and the *Brachyramphus* Murrelets, which breed far inland from the coast. The theory remains a successful generalization about seabird demography, and one of the most powerful among those relating life-history strategies to ecology. However, perhaps because of its success and obvi-

ous validity, it has attracted little research to elucidate mechanisms by which life-history strategies have evolved and been maintained. Moreover, the *Larus* gulls, with high adult survival and a constant 3-egg clutch remain an enigma in search of an explanation. In addition, adaptive reduction in clutch and brood size, resulting in low reproductive rates and combined with high adult survival has population consequences that include strong damping of population fluctuations and delayed response to changes in environmental conditions. These have hardly been explored, either in theoretical or empirical terms. This paper traces ideas about life-history evolution in seabirds, in the context of Lack's generalization about the importance of food in population regulation. I examine the evidence that seabirds are limited by food supplies, either in winter or summer, and the relationship between food-limitation and life-history strategy, and point to directions for future research on seabird life histories.

### AGE STRUCTURING IN AN EXPANDING THICK-BILLED MURRE COLONY

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The breeding sites of Thick-billed Murre (*Uria lomvia*) banded as chicks, that have recruited to the colony at Coats Island, northern Hudson Bay over the past 8 years were mapped in 1997. This mapping reveals that in established breeding areas, where sites have been occupied since the mid-1980s, recruitment of cohorts occurs randomly, most recruits being at least six years old. In contrast, on recently colonised areas, there is marked segregation by cohorts, with a high representation of birds that were 4-6 years old at the time when the area was colonised. This pattern gives rise, in some areas, to an age structuring within the colony that would be undetected in the absence of birds of known age. As age has a strong effect on many aspects of breeding biology, the possibility of age-structured colonies must be born in mind when selecting sites for biological monitoring or research activities, especially if the colony is known to have expanded recently. At stable colonies the effect is less likely to be of importance.



## ABSTRACTS

### EFFECT OF A STORM ON CHICK GROWTH IN LATE-NESTING BLACK NODDIES

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Birds nesting late in the breeding season often have poorer success than earlier breeders, sometimes due to weather. I studied chick growth and mortality in late-nesting Black Noddies on Heron Island, Australia. When adults were feeding nearly-fledged chicks, a week of strong winds and rough seas (associated with nearby cyclone) apparently made foraging difficult. Chicks which fledged before the storm fledged on-time, but fledging was delayed in 36% of chicks, for up to 3 weeks past average age of 44 days (recorded earlier that season). Nestlings typically exceed adult weight, then lose weight 1-2 weeks before fledging. When the fledging period was extended, weight loss continued, thus average fledging weight was significantly lower (82 g) than in on-time fledglings (95 g). While body weight decreased in delayed-fledging chicks, wing and culmen growth slowed but continued, ceasing in a few just before fledging or death. Storm-related food-stress did not greatly increase mortality: 7% of nearly-fledged nestlings at time of storm ( $n = 55$ ) soon died of exposure or starvation; earlier that season, mortality rate of nearly-fledged nestlings was 4% ( $n = 76$ ). Slowing growth while extending the fledging period may be an adaptive response enabling nestlings to survive large, unpredictable fluctuations in their food supply.

### A MARK-RECAPTURE TECHNIQUE FOR BEACHED BIRD SURVEYS

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Beached-bird surveys are often used to document seabird mortality and compare temporal and spatial patterns of mortality. During the summer of 1997, we conducted beached-bird surveys along a 27-mile stretch of beach on the outer Washington coast and initiated a mark-recapture study to test the feasibility of using such a technique. To follow individuals, we marked beached-bird car-

casses using unique combinations of colored cable ties on the bill, wings and/or legs. On subsequent surveys, birds were noted as new or marked. Data taken included species, age (adult, sub-adult, juvenile, chick), a condition index (degree of scavenging or decay), evidence of brood patches, carcass weight, and relative height on the beach. We marked over 1800 carcasses from June 14 to August 13. There were differences among species in both deposition and persistence on beaches. Common Murres composed 79% of the bird carcasses, and larger carcasses were scavenged or buried less than others. Given estimates of deposition and persistence, short-term mark-recapture studies may be useful for estimating long-term temporal and spatial patterns of mortality, especially when human or financial resources are scarce.

### TOURISTS AND SEABIRDS ON THE GREAT BARRIER REEF

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The Great Barrier Reef Marine Park and World Heritage Area is amongst the largest multiple use marine parks and is the largest World Heritage site in the world. Twenty two species of seabirds nest on 80 islands within the Park. By year 2001 most of the islands will be within daytrip range of urban centres. The ecological impact of visitors on tropical seabirds remains unquantified. At present, there is no scientific justification limiting visitation to seabird islands. Current monitoring schedules over most of the Great Barrier Reef are generally unable to establish if populations are decreasing or increasing. In those cases where trends are detected, as at Michaelmas Cay and the Swain Reefs cays, the cause is not determinable. Two studies now address the issue of visitor impacts on seabird populations. In one, the breeding success of bridled terns is compared between two control colonies and three colonies which receive simulated tourist disturbance. The other will quantify birds' response to tourists' presence as a function of distance between the tourist area (which will be spatially manipulated) and the nesting birds. Preliminary results will be presented.

### MARBLED MURRELET HABITAT SELECTION IN THE WESTERN OLYMPIC PENINSULA, WASHINGTON

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We examined habitat selection of the Marbled Murrelet utilizing use versus availability analyses and described the characteristics of Marbled Murrelet nests on the Olympic Peninsula, Washington. Nests were found in 1996 ( $n=4$ ) and 1997 ( $n=15$ ) by intensive, systematic tree climbing in 3 sites of varying age and tree species composition. All potential nest trees in thirty random plots (40 meter radius) containing approximately 650 trees were climbed. Habitat variables were measured and analyzed at four hierarchical scales at nest and non-nest sites; including stand, plot, tree, and limb/platform levels. Western Hemlock trees ( $n=18$ ) appeared to be selected for nesting, with no nests located in Western Red Cedar, Sitka Spruce, or Silver Fir. One nest was located in a Douglas Fir on the north side of the Olympic Peninsula where Douglas Fir is often the sole dominant tree species. Preliminary results indicate selection of Western Hemlock trees as nest sites is due to platform quality and higher available cover around nest limbs. This nest tree selection behavior has major implications on how land managers: 1) assess habitat quality; 2) protect nesting habitat; 3) improve habitat quality; 4) develop new habitat and; 5) gauge the contribution of certain forest types to the conservation of the population.

### SEABIRD STUDY OVER 25 YEARS - PROGRESS APLENTY

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The study of seabirds once involved a dedicated fieldworker, typically equipped with binoculars, bird-bands and notebook who spent several seasons on a remote island. Now it often involves a multi-disciplinary team deploying high-tech electronic devices from which data are downloaded directly onto state-of-the-art computers. This transition has been apparent in my own career which started with observational studies in Galapagos and the Welsh islands and now focuses on one small Scottish island but with close collaboration with molecular biologists,



## ABSTRACTS

virologists and fishery scientists. The aim of my talk is to review how seabird studies, both world-wide and in the Pacific, have developed over the last 25 years and to assess some of the major advances that have occurred during this time. To achieve this I use the contents list of the major ornithological journals, 17000 references to seabirds in the Zoological Record data-base, a general appeal via the seabird server on the World Wide Web and a poll of delegates at this conference. These indicate that studies on pollutants, birds-at-sea (both distributional survey and the use of telemetry to follow and monitor individual birds), and conservation have become increasingly important whereas those dealing with taxonomy, banding and behavior have fallen out of favour.

### DEFERRED MATURITY IN SEABIRD CONSERVATION AND MANAGEMENT: THE PROMISE AND REALITY OF ENVIRONMENTAL LAW

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There has been a revolution in U.S. environmental law during the past quarter century that establishes a strong legal framework for the long-term protection of seabirds and their habitats. In the early 1970s, the natural resource agencies that manage seabirds were reorganized and modernized. Congress enacted the Clean Water Act (1972), Fishery and Conservation Management Act (1976), and Oil Pollution Act (1990) which established strong regulatory programs that can protect seabirds at sea. The Endangered Species Act (1973), migratory bird treaties with Japan (1972) and USSR (1976) and various statutes that manage and fund the purchase of public lands can protect seabirds on land and at sea. Despite these advances in law, the natural resource agencies that manage seabirds have not yet achieved the full promise of the new legal protections. Agencies have wide latitude in fashioning programs that are beneficial to seabirds and in determining whether to bring enforcement actions against those who violate the laws. Their agendas are set by officials who must answer to diverse public interests. Conservationists must insure that the protection afforded by law is realized by monitoring the agencies and reminding the public of the importance of seabirds.

### TERRITORY QUALITY OF BLACK OYSTERCATCHERS IN THE STRAIT OF GEORGIA, BRITISH COLUMBIA

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Black Oystercatchers (*Haematopus bachmani*) are resident shorebirds of rocky intertidal habitats and defend breeding territories in the Strait of Georgia, B.C. The overall objective of this study is to identify components of territory quality for breeding oystercatchers. A key issue in the Strait of Georgia is the conservation of rocky intertidal habitats, and the ability to predict territory quality independent of bird performance will service in conservation efforts for this area. Three types of evidence will be examined to infer territory quality: [1] permanency of territory occupation, [2] physical characteristics of the breeding territory, such as territory size and [3] prey availability within the territory as a critical resource during the chick rearing period. Given that the bulk of chick provisioning is done within territory boundaries, the amount of resources available is likely the primary determinant of territory quality, responsible for variation in oystercatcher fecundity.

### TWENTY FIVE YEARS OF OBSERVATIONS BY STUDENTS AT THE OIMB PELAGIC CORMORANT COLONY ON THE CENTRAL OREGON COAST. IS THERE A CORRELATION BETWEEN POSITIVE SEA SURFACE TEMPERATURE ANOMALIES AND BREEDING SUCCESS?

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Undergraduate students at the Oregon Institute of Marine Biology have monitored a nesting colony of Pelagic Cormorants approximately 3km north of Cape Arago (43° 18' 45" N, 124° 24' 5" W) from mid June to early August since 1973 with the exception of 1979. Total number of nests constructed, the number of nests with eggs, and breeding success (measured as number of chicks fledged/number of nests with eggs) were correlated with sea surface temperature (SST) anomalies from NOAA's Coast Watch advisories and a synthesis of global sea surface temperatures from Allan, Lindesay and Parker (1996).

Years in which breeding success is above normal show no distinct association with SST anomalies. Years in which breeding success is below normal are associated with positive SST anomalies for the first six months of the year. However, the presence of a positive SST anomaly does not necessarily mean that pelagic cormorants have a low breeding success as in five of the eleven years with a positive SST anomaly breeding success was above the norm.

### FORAGING HABITAT PREFERENCES OF BRANDT'S CORMORANTS OFF THE SANTA CRUZ COAST

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Brandt's Cormorants are important constituents of nearshore waters off California. They likely have significant predatory impacts on subtidal communities, thus making it interesting to know in which particular subtidal habitats they prefer to forage. This study examines the use by foraging cormorants of habitats with these variables: 1) percent cover of kelp-forest canopy and understory/groundcover algae, 2) substrate type, 3) exposure to heavy winds and seas, and 4) proximity to nesting/roosting areas. Brandt's Cormorants were observed foraging in two distinct ways: singly or in close association with other cormorants and/or seabirds. For cormorants foraging singly, habitats with rocky reefs were used significantly more than habitats with sandy bottoms. However, cormorants foraging in groups showed no substrate preferences. Also for solo foraging cormorants, the percent cover of kelp-forests, but not understory/groundcover algae, was positively correlated with usage. The number of cormorants that foraged in groups was unrelated to understory/groundcover algae as well, but data were insufficient to determine the relationship between group foraging and the percent cover of the kelp-forest. Both group and solo foraging cormorants preferentially used sites that were in close proximity to a colony or roost. Both group and solo foraging cormorants preferentially used sites that were less subject to long-term exposure by heavy winds and seas.

### STABLE ISOTOPE ANALYSIS REVEALS IMPORTANCE OF INTRODUCED RATS AS PREDATORS OF BURROW-NESTING SEABIRDS ON LANGARA ISLAND, BRITISH CO-

## LUMBIA

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On Langara Island, British Columbia, the burrow-nesting Ancient Murrelet (*Synthliboramphus antiquus*) has declined tremendously in recent decades. The Norway Rat (*Rattus norvegicus*) has been implicated as a major factor in this decline. We evaluated the importance of murrelets in the diets of rats using stable-carbon ( $\delta^{13}\text{C}$ ), nitrogen ( $\delta^{15}\text{N}$ ), and sulfur ( $\delta^{34}\text{S}$ ) isotope analysis of muscle and liver tissues of rats and of prey organisms from three regions of Langara Island. Rats were segregated isotopically into three groups corresponding to upland, littoral and seabird nesting areas. We interpret these groups to represent rats consuming predominantly terrestrial foods, intertidal invertebrates and Ancient Murrelet tissues, respectively. Carbon isotopes segregated marine vs terrestrial diets, whereas nitrogen isotopes were useful in segregating marine invertebrates and seabirds as prey items. Sulfur isotope analysis was not useful likely due to the presence of marine-derived sulphates in the terrestrial foodweb. Our results have important ramifications for dietary investigations of introduced fauna and their impacts on native seabirds on oceanic islands.

## ANTARCTIC FULMARINE PETREL TROPHIC RELATIONSHIPS: A STABLE ISOTOPE APPROACH

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We employed stable isotope analysis to investigate marine trophic relationships among the Antarctic fulmarine petrel community breeding on Hop Island, Prydz Bay, Antarctica. We measured stable-carbon ( $\delta^{13}\text{C}$ ) and nitrogen ( $\delta^{15}\text{N}$ ) isotopes from blood samples from breeding adults and chicks during the 1994-95 (n = 123) and 1995-96 (n = 160) breeding seasons and from representative prey items. ( $\delta^{13}\text{C}$  was not a useful indicator of trophic position but did indicate that all

four species foraged pelagically rather than inshore. In contrast, ( $\delta^{15}\text{N}$  was a useful indicator and ranged from 3.98 (0.21 o/oo for Antarctic krill to 11.98 (0.64 o/oo for snow petrel chicks. ( $\delta^{15}\text{N}$  values showed step-wise trophic enrichment. Consistent with known diets, snow petrel chicks showed highest trophic positions. Trophic positions of Antarctic and Cape Petrels and Antarctic Fulmars overlapped extensively. There were no consistent trends suggestive of dietary shifts either within or between breeding seasons. Breeding adults of all four species fed their chicks higher trophic level diets (higher proportions of fish) than they consumed for themselves. Elucidation of seabird community trophic relationships contributes to our understanding of marine ecosystem processes and structure.

## DIETARY RESPONSES OF TERNS AND SKIMMERS TO SHIFTING PREY ABUNDANCE IN THE SOUTHERN CALIFORNIA BIGHT

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We compared the proportion of northern anchovy to that of Pacific sardine, a warmer water fish, in the diets of three species of tern and skimmer nesting at the Bolsa Chica Ecological Reserve in southern California over a five-year period (1992-1996) based on dropped fish samples. This comparison of the two most common prey species at the Bolsa Chica colony was prompted because of a more than 10-year trend of anchovy decline and sardine increase in the Southern California Bight, perhaps in part as a result of warming temperatures in this ocean environment. We proposed that the Elegant Tern, the most abundant colony member and an almost exclusively ocean forager, would show the strongest response to changing anchovy and sardine abundance despite the claim that it is dependent on anchovy abundance for its reproductive success. This expectation was borne out in that the anchovy-sardine ratio among fish dropped by Elegant Terns at their nests steadily declined from 35:1 in 1992 to 2.6:1 in 1996. Caspian Terns and Black Skimmers shifted less dramatically toward sardines, perhaps because of their broader diets and generally greater use of sardines as prey items.

## STATUS OF THE MARBLED MURRELET IN THE INNER NORTH COAST RANGES OF NORTHWESTERN CALIFORNIA

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During 1995-96 we surveyed for Marbled Murrelets within 2 late mature/old-growth Douglas-fir habitats. We used the generalized binomial model to determine sample sizes and to estimate the power of survey results for a range of assumed levels of murrelet occurrence ( $p$ ) and probabilities of detection ( $p'$ ). No murrelets were detected during 2184 surveys at 273 random sites. When a  $p$  of 0.03, and a  $p'$  of 0.10 were assumed, the probability that murrelets would have been detected if present was 0.95 and 0.81 for the 2 habitat types. Most habitat characteristics were similar to known murrelet nesting habitat. However, a hotter and dryer climate, relatively high elevation, and low amounts of moss in potential nest trees may have explained the absence of the murrelet. This new information resulted in changes in survey requirements.

## SEABIRD RESTORATION EDUCATION PROGRAM

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Action Learning is a method of environmental education which provides students with opportunities for active involvement in local environmental projects. The objectives of the Seabird Restoration Education Program are for students to be able to: 1) describe seabirds of the central California coast; 2) describe reasons for seabird decline: egg collecting, gill net fishing, oil spills, and disturbance; 3) describe efforts to restore seabirds, specifically efforts to restore Common Murres to Devil's Slide Rock, and 4) actively participate in the Common Murre



## ABSTRACTS

Restoration Project. The education program has involved 18 teachers and nearly 1,000 students from San Mateo County coastal schools. Biologists are using social attractants (decoys and amplified murre calls) to restore a breeding colony of Common Murres to Devil's Slide Rock. The associated education program was implemented in September of 1996. Each school year begins with a workshop for teachers; relevant curriculum materials are provided so activities can be taught throughout the school year. After biologists remove the decoys from Devil's Slide Rock, the students actively participate in the restoration project by repainting decoys. When the decoys are redeployed, students keep track of daily high counts of murres, numbers of eggs, and numbers of chicks, using data charts.

### SATELLITE TELEMETRY OF BLACK-FOOTED ALBATROSSES (*Diomedea nigripes*) DURING THEIR SUMMER DISPERSAL OFF SOUTHERN CALIFORNIA

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After breeding in the Central Pacific, Black-footed Albatrosses (*Diomedea nigripes*) disperse across the entire North Pacific unrestrained by their duties at the colony. Here I provide the first tracking data for Black-footed Albatrosses and describe the first attempt to track albatross movements during their pelagic dispersal. ARGOS transmitters were attached to three albatrosses on 10-11 July 1997 during an oceanographic cruise off Southern California. Two birds were equipped with transmitters functioning on a continuous duty cycle: albatross #1 was followed for 11 days, during which it traveled 1787 km (430 km straight-line distance from release site), and bird #2 was tracked for 12 days and 1670 km (150 km straight-line distance). Finally, a third albatross equipped with a transmitter operating on a one week duty cycle traveled 5067 km during 35 days. Three conclusions arise from this study: off Southern California, (1) Black-footed Albatrosses are not restricted to foraging ranges in the order of 40-60 nautical miles as hypothesized by Miller (1936, 1940); they range over hundreds to thousands of km, (2) Black-footed Albatrosses do not restrict their movements to the highly productive, cool waters of the California Current as proposed by Miller (1940); they venture into

Central Pacific and Transition Zone waters; and (3) analyses at finer scales reveal that albatrosses engage in "traveling" and "searching" behaviors, with "searching" bouts taking place in the vicinity of regions of strong thermal gradients and seamounts.

### A STUDY OF GENETIC STRUCTURE AND KIN GROUPS IN THICK-BILLED MURRE

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Within a species, populations are likely to show some degree of genetic and phenotypic differentiation. Within a population, further genetic substructuring may occur due to non-random mating, barriers to the exchange of individuals, philopatry with respect to breeding site, or due to the presence of kin groups. Subdivision of a population into kin groups can facilitate the evolution of 'helping behaviours' through kin selection. Thick-billed Murres (*Uria lomvia*), arctic colonial cliff-nesters, generally return to breed on their natal ledges. Over a few generations the formation of kin groups may be facilitated. In a previous study at Hornoya, Norway, murres nesting on ledges were found to be related, on average, to the level of first cousins. In other murre colonies phenotypic variation has been reported to occur in clusters. Alloparenting behaviour such as brooding, feeding, or adoption by adults of non-biological chicks has been observed in murres. Alloparenting behaviour, in addition to philopatry with respect to breeding site, and phenotypic clustering in some colonies raises the question of presence of kin groups within other colonies. Using mitochondrial DNA and microsatellites, a colony of Thick-billed Murres on Coat's Island, NWT, is being examined to obtain information on genetic structuring and kin groups.

### SPATIAL DISTRIBUTION OF STELLER'S EIDERS AND POMARINE JAEGER IN BARROW, ALASKA

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Nesting Steller's Eiders and Pomarine Jaegers were studied at Point Barrow, Alaska in 1995-97. Nests were located on foot surveys and locations were recorded by GPS (Global Positioning System). Measurements were taken between each eider nest and the two closest eider nests, and between each jaeger nest and all eider nests within 300m. All other inter-nest distances were estimated by computing the distance between GPS points. Nests were plotted on digitized maps. A comparison of the area-wide distribution of eider nests with a random distribution (corrected for unsuitable habitat) revealed a clumping of eider nests both within and between seasons. Further, eider nests were non-randomly clustered around the sites of Pomarine Jaeger nests. This distribution is interesting given that Steller's Eiders are not considered colonial, and that the Pomarine Jaeger is a major egg and duckling predator. The observed distribution may play a role in or result from breeding philopatry, kin selection and/or nest defense.

### THE PROGRESS OF SEABIRD BEHAVIOR RESEARCH: 25 YEARS OF INDIFFERENCE TO A SCIENTIFIC REVOLUTION?

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Behavior is fundamental to seabird biology because it determines how individuals search for food, feeding areas, nest sites, and mates, it regulates decisions about reproductive effort that determine life history, and it determines how individuals respond to natural and human-made environmental change and catastrophes. The last 25 years has seen rapid growth of the Behavioral Ecology paradigm, emphasizing an evolutionary approach invoking individual selection. This approach provides the opportunity for crucial insights into seabird ecology. Nevertheless, considerations of behavior has generally been peripheral to Pacific seabird research, which has concentrated on descriptive studies of distribution, population dynamics, physiology and diet. Exceptions to this trend include studies of seabirds' responses to predators, parent-offspring communication, sperm compe-



tition, and foraging behavior at sea. Recent improvements in genetic (e.g., DNA fingerprinting), field monitoring (e.g., time-depth gauges, satellite telemetry, pit tags, and radar), and modeling techniques (e.g., GIS and capture-mark-recapture analysis programs such as SURGE and SURPH) provide exciting opportunities if we decide to use them to address the right questions. Solutions to a broad range of theoretical, management and conservation issues in seabird ecology will benefit from a greater emphasis on behavior combining both ecological and evolutionary approaches.

# **MARBLED MURRELETS, THREE NESTINGS, CHICK AND ADULT BEHAVIOURS COMPARED**

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One hundred and four Marbled Murrelet chick feedings were observed by the author and a small group of researchers representing Friends of Caren at two separate nest sites and three nestings during 1993, 1994 and 1997. All nestings took place on the Caren Range of British Columbia's Sunshine Coast. A summary has been prepared which documents feeding times related to sunrise and sunset, duration of feedings, frequency of visits by both adults, variations in arrival and leaving behaviours of adults and kinds of fish fed to the chick. Vocalisations of adults and chicks at the nest were noted and some of these were recorded using directional and parabola microphones. The total number of volunteer hours spent in recording breeding information was 73.5, 36.5 and 101.5 hours in 1993, 1994 and 1997 respectively. In those same years a total of 94 feedings were timed, with 40, 14 and 40 feedings respectively. Total feeding durations in the same years were 531, 166 and 560 minutes respectively. The 1993 successful nesting was from 7-20 August, while both 1994 and 1997 nestlings fledged on 3 and 1 July, respectively. Fledging behaviour is described.

# **KRILL VS. FISH: POTENTIAL FOR PREY-SWITCHING AMONG PYGOSCELID PENGUINS IN A RAPIDLY CHANGING ENVIRONMENT**

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Three species of penguins breed on King George Island, Antarctica, the Gentoo, Adelie and Chinstrap penguin. Krill is a major component of the diet of each species, however, they also consume fish. We analyzed the composition and percentage of fish taken by each of the three species of penguin. Diet samples were obtained by lavaging five breeding adults of each species every week during chick rearing period for five consecutive austral summers. These data indicate major differences in diets among the penguin species. Krill populations have been negatively affected in the past decades due to a decrease in heavy winter ice on which they depend for survival of young individuals. In addition, an active krill fishery has developed adjacent to the breeding colony. If krill becomes limited as a result of climate change and/or expanding commercial fisheries, the penguins may come to rely more on secondary prey items. Changes in the percentage of, or shift in species assemblages of fish eaten, could reflect variations in environmental conditions and/or impacts caused by human commercial activities. Results of this study point to the importance of paying closer attention to prey items heretofore considered incidental.

# **BIOLOGY AND CONSERVATION OF THE BLACK-VENTED SHEARWATER**

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Little has been published on the biology of the Black-vented Shearwater. It breeds on only three island groups in northwest Mexico: Natividad, San Benitos, and Guadalupe. All three island groups have permanent human inhabitants and introduced mammals, both of which are known to negatively effect seabirds. Data on the breeding biology and natural history of the Black-vented Shearwater and the impacts of humans and introduced mammals are essential for informed management of this Baja California endemic. In 1997 I spent four months on Isla Natividad which supports perhaps 90 percent of the world's population, studying the natural history of the Black-vented Shearwater. The colony covers 2.5 km<sup>2</sup> and most suitable habitat is occupied by burrows. I estimated the number of burrows on the island to be 114,455  $\pm$  27,520. Burrow occupancy was 66.9% (n=171). The esti-

mated number of breeding pairs is 76,570  $\pm$  18,411. Birds appear to attend the colony year round. Laying begins in March, hatching occurs in May and fledging occurs about 70 days after hatch (range 62 to 72 days, n=4). The main threats to Black-vented Shearwaters on isla Natividad are introduced cats, the building of new roads, and the disposal of garbage in the colony.

# **WATERBIRD INJURY DETERMINATION AND RESTORATION IN CALIFORNIA, 1986-1997**

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With the advent of the federal Oil Pollution Act of 1990 and the California Oil Spill Prevention and Response Act of 1990, new regulatory provisions for natural resource damage assessment and restoration were mandated. Beginning in 1986 the trustee agencies for seabird resources in California conducted increasingly focused wildlife injury determinations. The U.S. Coast Guard Area Contingency Plans for California direct the trustees to collect time sensitive data which can be used to quantify wildlife injuries. These activities are described. Eight damage assessments, (one currently in progress) are profiled and waterbird restoration strategies in seven cases are reviewed.

# **MARINE BIRD ABUNDANCE IN PRINCE WILLIAM SOUND, ALASKA: TRENDS FOLLOWING THE T/V EXXON VALDEZ OIL SPILL**

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It was found that several marine bird species were injured by T/V Exxon Valdez oil spill. This study was initiated to monitor recovery of these injured species. We conducted surveys of Prince William Sound during March and July between 1989 and 1996. We then estimated and compared the populations of marine birds in oiled and unoled zones. During March, cormorant, goldeneye, scaup, Bald Eagle, and Herring Gull populations showed

significant differences between the zones. All results, except scaup, were consistent with an oil spill effect. During July, scoters, jaegers, Black-legged Kittiwakes, gulls, Kittlitz's Murrelets, Horned Puffins, and all puffins showed significant differences in the two zones. Scoters, jaegers, kittiwakes, and gulls had results consistent with an oil spill effect. The results for the other species showed possible recovery. Although these data indicate that some species are exhibiting recovery, most are not. Thus, recovery of many marine bird species from a large perturbation, such as the *TV Exxon Valdez* oil spill, is not statistically detectable with data from five surveys.

#### BARREN ISLANDS SEABIRD STUDIES

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As part of the five-year-long Alaska Predator Ecosystem Experiment (APEX, a project sponsored by the *Exxon Valdez* Oil Spill Trustee Council consisting of 16 seabird and forage fish studies in Prince William Sound and lower Cook Inlet), we collected data on several breeding and foraging parameters of Common Murres, Black-legged Kittiwakes, and Tufted Puffins at the Barren Islands since 1995. Breeding parameters included nesting chronology, productivity, and chick growth rate; foraging parameters included adult nest attendance and foraging trip duration, and chick feeding frequency and meal size. The three seabird species were chosen for study because they have different foraging strategies. By comparing information from these species within and among years and among other colonies, we hope to increase understanding of how seabirds respond to changes in food availability and quality. We also monitored the prey base by collecting data on chick and adult diets and by beach seining near the colonies. Another APEX research unit conducted hydroacoustic and trawl surveys to obtain additional information on the food web. Some preliminary comparisons from our 1995-1997 data are presented in this poster.

#### WITHIN-COLONY VARIABILITY IN KITTIWAKE PRODUCTIVITY

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Food availability during the breeding season is generally considered the most important factor regulating the productivity of seabirds. Paradoxically, spatial heterogeneity in reproductive performance is a common feature of seabird breeding colonies despite the fact that all individuals potentially have access to the same food resources. I studied within-colony variability in the productivity of Red-legged Kittiwakes and Black-legged Kittiwakes on St. George Island by monitoring the fate of nests on 273 photographic plots. For each year of the study (1993-95), I found greater among-plot variability in productivity than could be attributed to chance: nests within plots tended to experience a common reproductive fate. Although my analyses identified several factors that may have contributed to spatial heterogeneity in kittiwake reproduction (nest density, elevation, plot size, species composition, plot aspect), these factors only partially account for variability among plots. I restricted my analyses to plots that shared common attributes for the above factors and still found significant variability among plots. Reproductive variability cannot be explained by localized predation or differences in bird quality between plots. Therefore, I tentatively propose that social facilitation may be responsible for spatial heterogeneity in kittiwake productivity on St. George Island.

#### AGE-RELATED DIFFERENCES IN IMMUNE FUNCTION AND LAYING DATE IN CASSIN'S AUKLETS

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Recent studies indicate that a relationship exists between reproductive effort and immune function. Immune function being defined as a baseline measurement of immune system activity. The immune system prevents initial infection and the production of pathogens after the initial infection takes place. Immune function becomes expensive through the cost of mounting an immune response against an infection. I compared laying date, a measure of reproductive effort, with a differential white blood cell count, heterophil : lymphocyte ratios, in two different age-classes of Cassin's Auklets on Triangle Island, BC. High heterophil : lymphocyte

ratios are associated with disease, stress, and starvation. Since immune function is expensive, my prediction was that early laying individuals should have low immune function, while late layers should have high immune function. Young females had significantly higher H:L ratios and laid significantly later than old females indicating an age-related cost to reproduction. Old females showed a strong positive correlation between H:L ratios and laying date, while young females did not, suggesting that the younger age-class is not making the trade-off between current reproductive effort and future reproduction and survival.

#### SEABIRD MANAGEMENT ON LAND: PAST PRACTICES AND FUTURE TRENDS IN THE CONSERVATION OF SEABIRD NESTING HABITATS

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Seabirds and their nesting habitats have traditionally been protected by legislation and establishment of nesting sanctuaries. At sanctuaries, management usually consists of habitat acquisition by conservation agencies and non-profits, posting and enforcement of wildlife laws by wardens. While habitat protection - especially of large, productive colonies - must remain the backbone of seabird protection on land, this largely passive approach does not necessarily lead to restoration of historic breeding sites, range expansion, increased diversity, protection from introduced or native predators or public education. Increasing human populations and intensive land use along our coasts are putting severe pressure on many seabird populations. These pressures often favor adaptive species such as Western Gulls and Double-crested Cormorants, while specialists such as Roseate Terns and Marbled Murrelets become threatened and endangered. More proactive techniques for seabird conservation are necessary to protect the diversity of Pacific seabirds. This paper presents case studies demonstrating the value of proactive techniques for seabird protection and restoration, including predator control, reserve design, social attraction, translocation and public education of special interest groups.



## ABSTRACTS

### MARBLED MURRELET PRODUCTIVITY RELATIVE TO FORAGE FISH ABUNDANCE AND SPECIES COMPOSITION

Katherine J. Kuletz\* and Steven J. Kendall. U.S. Fish and Wildlife Service, 1011 E. Tudor, Anchorage, AK, 99503. kathy\_kuletz@mail.fws.gov.

We present evidence that forage fish abundance is correlated with Marbled Murrelet productivity. We also suggest a possible link between diet and murrelet chronology and productivity. We conducted at-sea surveys to index murrelet productivity in Prince William Sound, Alaska, in 1995 (4 sites), 1996 (1 site), and 1997 (3 sites). At each site we repeatedly surveyed waters 0-200 m offshore in June, July and August. The APEX forage fish study surveyed fish abundance at these sites with hydroacoustics in July and August of each year. In both 1995 and 1997, average nearshore fish biomass was positively and significantly correlated with average juvenile murrelet density at the sites. At the site with 3 years of data (Naked Island), juvenile murrelet density paralleled annual changes in nearshore fish biomass. In 1997 we identified fish species held by adult murrelets prior to delivery to chicks. At one site where >80% of the chick diet was Pacific sand lance, fledging began and peaked earlier, and fledgling densities were higher, than at a site where >80% of the murrelet diet was Pacific herring.

### GENETIC DIFFERENTIATION OF HARLEQUIN DUCK POPULATIONS WITHIN AND BETWEEN THE ATLANTIC AND PACIFIC COASTS OF NORTH AMERICA

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The possible listing of Harlequin Ducks on the Atlantic Coast and concerns regarding recovery of the species in Prince

William Sound, Alaska (subsequent to the Exxon Valdez Oil Spill), have raised questions about the extent of population differentiation and movement across the species' geographic range. Due to lack of observational evidence of movements among regions, we used genetic markers which differ in mode of inheritance and rate of evolution to evaluate the degree of genetic differentiation among geographically separate populations within and between the Pacific and Atlantic Coasts. Analyses of microsatellite loci indicate allele frequencies are quite similar among populations within the Pacific (Alaska to Oregon) and Atlantic Rims (Iceland to Nova Scotia). Similarly, Pacific and Atlantic Rim populations had similar allele frequencies, suggesting that either the species as a whole has undergone little genetic change since glaciation or gene flow is still occurring over broad geographic areas. On-going mitochondrial DNA analyses will reveal the extent of female-mediated gene flow and degree of phylogeographic structuring within and between the two regions.

### SCALE-DEPENDENT SPATIAL VARIANCE PATTERNS AND CORRELATIONS OF SEABIRDS AND PREY IN THE SOUTHEASTERN BERING SEA AS REVEALED BY SPECTRAL ANALYSIS

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Uni- and bivariate spectral analyses of the spatial distribution of Thick-billed Murres and acoustic estimates of prey biomass in the southeastern Bering Sea were used to examine the spatial variance patterns of a predator and its prey at multiple spatial scales. Power, phase and coherency spectra from individual transects, as well as those averaged over all transects, were examined. The average spectra, representing a temporal scale of months, showed that murres and prey had similar spatial variance patterns and were positively correlated over the range of spatial scales studied. The individual spectra, representing a temporal scale of hours, showed several patterns that were not evident in the average spectra. In particular, the transect-level analyses showed that the correlation between murres and prey was poor at spatial scales where prey variance was relatively low. This result suggests a new hypothesis to explain poor small-scale correlations between con-

sumers and resources: resource distribution is relatively uniform at small scales resulting in only a slight increase in foraging return for consumers showing an aggregative response at these scales. The differences among spatial scales and between the average and individual spectra illustrate how ecological patterns can vary with temporal and spatial scale.

### MONITORING MARBLED MURRELETS WITH RADAR IN DESOLATION SOUND, BRITISH COLUMBIA

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I monitored the annual flight of Marbled Murrelets through Theodosia Inlet (a narrow fjord off Desolation Sound, British Columbia) with radar during the breeding seasons of 1996 and 1997. At the same time, human observers counted birds using standard audio/visual detection methods. I compared daily and seasonal numbers of birds between 1996 and 1997, and calculated the inter-annual coefficient of variation (necessary for calculation of power) and generated power curves for both human and radar monitoring. In addition, I used the information from radar monitoring to augment our group's demographic study.

### DEMOGRAPHY OF MARBLED MURRELETS IN DESOLATION SOUND, BRITISH COLUMBIA

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Since 1991 our group has banded 774 adult Marbled Murrelets in Desolation Sound. Murrelets can be reliably captured using mist nets on floating rafts. In 1997, we captured 172 new adults and recaptured 39 birds banded previously with mist nets, allowing us to estimate survival and population size. We recaptured a bird banded in 1991, extending the longevity record for murrelets to 8+ years. In addition, the dip net technique resulted in 109 new captures, 8 recaptures from previous years and 28 juveniles. The juveniles are our first sample of known age birds. We marked 69 adults and 15 juveniles with combinations of wing tags, radio transmitters and nasal disks. To investigate murrelet movements, distribution and use



of the marine environment. We conducted regular marine surveys throughout the breeding season, using both marked and unmarked birds. We found both diel and seasonal shifts in habitat use. In September 1996, a bird which we had banded in 1995 was recaptured in northern Washington by American researchers. We recaptured the same individual this year, providing the first evidence of seasonal movement. Our results suggest that the marine habitat must be considered for effective conservation measures.

#### COMPARISON OF SURVEY METHODS FOR ASSESSING CORVID ABUNDANCE IN MARBLED MURRELET NESTING STANDS

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We conducted an artificial nest study on the Olympic Peninsula of Washington (1995 to 1997) and in the Coast Range of Oregon (1997) to assess the influences of stand and landscape level variables on the risk of nest predation to Marbled Murrelets. Concurrent with our artificial nest experiments, we conducted surveys of corvid abundance in our nest stands to examine a possible correlation between corvid abundance and nest predation rates. We censused corvids using a variety of techniques including point count surveys, transect surveys, and the broadcast of corvid territorial and predator attraction calls (to maximize probability of detection). We found point count values had the strongest correlation with artificial nest predation. We suggest using the maximum value for each corvid species attained from several point count surveys in each stand. Use of attraction calls may over-represent corvids at the stand level but is important in assessing the landscape-level presence of wide-ranging (ravens) and often non-vocal (Gray Jays) corvid nest predators.

#### STATUS AND TREND OF THE SAGUAGAHGA RED-FOOTED BOOBY COLONY ON THE ISLAND OF ROTA, COMMONWEALTH OF THE NORTHERN MARIANA ISLANDS

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A large breeding colony of Red-footed Boobies occurs in the Saguagahga region on the island of Rota, Commonwealth of the Northern Mariana Islands, USA. The colony lies in limestone forest along the southeastern coastline beneath 100 meter high cliffs and along a 200 to 500 meter wide plateau. Complete counts of birds, eggs, and nests have been recorded at least quarterly since 1992. Breeding occurs circannually, with as many as 700 nesting pairs active during the peak season between November and January. Population numbers appear stable, in spite of significant threats facing the colony, including development abutting the cliffline above the colony, poaching, and introduced predators. An overlook, which provides tourists an opportunity to observe nesting birds while minimizing disturbance, was constructed in 1991 over the southern portion of the colony. The Saguagahga region was established as a sanctuary in 1994 because it protects a wide variety of native plants, seabirds, and fruit bats, and represents a valuable ecotourism resource.

#### POPULATION TRENDS OF THE COMMON MURRE IN CALIFORNIA, OREGON AND WASHINGTON, 1979-1995

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Aerial surveys of breeding sites of Common Murres were conducted from 1979 to 1995 in California (Central and Northern), Oregon and Washington. Survey continuity varied among the four areas. Trend analyses were based on annual whole-colony counts. A correction factor of 1.67 was used to estimate total numbers of birds using colony-sites. In central California, murre trends declined from 1980-1995, with steep decline occurring in 1982-89 and limited increase in more re-

cent years. Trend analysis in northern California is more difficult due to less continuous colony data but the population appears to be stable. Oregon murre trends, based on 1988-95 data at 15 colony-sites, showed slow population decline. Washington has experienced a significant population decline and colonies show substantial annual variation in attendance. The most dramatic decline was along the southern Washington coast. The total number of individual murre attending colonies in California, Oregon and Washington was about 1.2 million; most birds now breed in Oregon and northern California.

#### MARBLED MURRELET HABITAT ASSESSMENT: TECHNIQUES TO MEASURE CANOPY DENSITY

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Canopy density is one variable measured when assessing Marbled Murrelet (*Brachyramphus marmoratus*) nesting habitat. Openings in the canopy facilitate travel through a stand by the murrelet, and may be important for access to nest sites. Three methods of measuring canopy density within a stand are compared for accuracy: 1) use of a densiometer; 2) measurement of gap openings using a 50 metre measuring tape, and 3) analysis of over-story photographs. Repeatability of individual gap measurements is examined to determine the validity of using this technique by different crew members. These results on the accuracy and precision of canopy density measurements can be used by researchers to choose the most appropriate method for Marbled Murrelet habitat studies. Estimations of cost and time required will also be considered in the suitability of these methods.

#### HABITAT CORRELATES OF MARBLED MURRELET NEST PREDATORS: STAND VERSUS LANDSCAPE ATTRIBUTES

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We investigated the relative abundance of Marbled Murrelet nest predators (jays, crows, ravens, and squirrels) from 1995 to 1997 on Washington's Olympic Peninsula and in 1997 on Oregon's central coast. Predators were surveyed using modified point counts (some longer observations and attractant calls were employed) in forested stands ranging in size from 30-110 ha. Each predator's abundance was influenced by unique habitat requirements, but stand-level attributes (structure, composition, and physical features) were typically less strongly correlated with abundance than were landscape-level attributes (proximity to human activity, % mature forest within 5 km of the stand, and landscape fragmentation). The amount and type of stand edge was also important. In general most predators were most abundant near human activity, in fragmented habitats, and in late successional forest. Managers and planners can increase their effectiveness at identifying and conserving murrelet nest areas by considering attributes of the landscape in addition to attributes of the nest stand.

## THE EVALUATION OF POTENTIALLY-INFLUENCING FACTORS ON INLAND DETECTION LEVELS OF MARBLED MURRELETS

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Many agencies and others are interested in evaluating impacts of forest harvest or manipulation in potential Marbled Murrelet nesting habitat. A primary tool for this evaluation is analysis of observations from surveys conducted at inland forest sites. As part of an effort to evaluate the current survey design, we examined the relative effects of spatial, temporal, and environmental variables (i.e. precipitation, cloud cover, and moon phase) on detection levels at several sites in northern California. Stepwise multiple linear regression analyses, using the maximum R-squared improvement selection procedure, indicated that most of the variation in detection levels could be accounted for by day-of-year and location, and a relatively small amount by cloud cover. We used best-fit polynomials of detection level as a function of day-of-year to compare patterns of detection levels through the sea-

son at high-, moderate-, and low-activity sites, and found no significant differences between sites. These results indicate that data collected at a single site in different years and under different weather conditions can be pooled, although it is important to adjust for within-season differences in order to compare detection levels between sites.

## THE PRIMITIVE STATE OF SEABIRD BYCATCH MANAGEMENT IN WORLD INSHORE GILLNET FISHERIES

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We reviewed available literature (97 papers) on seabird bycatch in inshore gillnet fisheries from 15 countries including two regions in Canada and four US states. Our objective was to determine the global scope of inshore gillnet bycatch including: seabird species caught, methods of investigation, extent of population level impacts, and the nature and effectiveness of fisheries management actions to reduce bycatch in these fisheries. Deep diving alcid species are most commonly entangled, especially Common and Thick-billed Murres and Razorbills and in some areas (North Sea) diving ducks are the primary species caught. At least eight techniques were used to evaluate bycatch ranging from anecdotal reports and fisher interviews to vessel or land based observer programs; few yielded bycatch rates or reliable population level impact assessments. From the papers reviewed we found that only in the US, in California and Washington, were direct management actions taken to reduce seabird bycatch, suggesting that in most countries of the world seabird bycatch management in inshore gillnet fisheries is at best in a primitive stage of development and rarely a resource management priority.

## DIE-OFF OF SHORT-TAILED SHEARWATERS AND OTHER SEABIRDS IN WESTERN ALASKA, SUMMER 1997

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In August 1997, dead and dying Short-tailed Shearwaters were reported in unusual numbers on beaches and nearshore

waters of Alaska, from the Alaska Peninsula to northeastern Russia and the Chukchi Sea. Frequencies of dead shearwaters on beaches were 5-50km<sup>-1</sup> on the Alaska Peninsula and 15-350km<sup>-1</sup> in the Bering Sea. Other species were affected in more limited area: Black-legged Kittiwakes along the Alaska Peninsula, and murres and possibly other diving species in parts of the Bering Sea. Dead shearwaters were much lighter in weight than live birds in good condition. Necropsied birds were emaciated, and parasitic but not microbial disease was present; death probably was due to starvation. Shearwaters died off over a similar area as during the El Niño year of 1983; other species were affected differently in the past. Sea surface temperatures were the highest recorded in Alaska. If this oceanographic anomaly intensifies next year, as expected, impacts on seabird populations may be observed.

## MARBLED MURRELETS, WHERE ARE THEY AND WHO ARE THEY WITH: DISTRIBUTION AND COMMUNITY RELATIONSHIPS OF THE MARBLED MURRELET IN THE NORTHERN PUGET SOUND AND HOOD CANAL, FALL AND WINTER 1995 - 1996

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We conducted marine seabird surveys in northern Puget Sound and Hood Canal in Northwest Washington from August - November in 1995 and 1996. We studied community relationships of the Marbled Murrelet (*Brachyramphus marmoratus*). Murrelets are associated with Pigeon Guillemots (*Cephus columba*). Some data suggest negative associations with Western Grebes (*Aechmophorus occidentalis*). Murrelets are typically found at distances of 250 - 350 meters off shore. For both years higher densities of murrelets were found in protected inlets and bays later in the season. The areas where murrelets associate with guillemots are believed to be areas with high prey densities. The birds do not form mixed foraging flocks rather they are linearly distributed over several kilometers. Sheltered waters offer protection for the birds in seasonally inclement weather.

## MARBLED MURRELET USE OF LANDSCAPES FOR NESTING IN SOUTHERN OREGON



## ABSTRACTS

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I evaluated the effect of fragmentation of old-growth forest stands in southwestern Oregon on use of these stands by nesting Marbled Murrelets (*Brachyramphus marmoratus*). Fragmentation indices were calculated on successional forest vegetation patches within 203 ha circular areas around occupied and unoccupied sites. Sites occupied by marbled murrelets had more interior habitat within old-growth patches and greater patch diversity than unoccupied sites. Total edge and patch shape were not important. Increased access of predators to nest sites is believed to be the major cause of the lower use of the fragmented habitats.

### PREY FISH SAMPLING BY FORAGING COMMON TERNS: A COMPARISON TO HUMAN TRAWL SAMPLING

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Hamilton Harbour (Lake Ontario) was designated in 1993 for study by the national Ecosystem Rehabilitation Program. As one part of that program, DJM and RDM used radiotelemetry to identify the primary foraging areas used by Common Terns. We assumed that prey fish delivered by terns to their chicks might be indicative of bait fish species diversity and abundance, but required a comparison with standard fisheries techniques. Accordingly, we collaborated with SKS during a one-week period in June 1995 to compare measures of relative fish diversity/abundance determined by (a) fish returned by foraging terns and (b) trawl sampling at locations where terns were known to forage. The two methods yielded different patterns of species composition and relative abundance of fish. Emerald Shiner was the predominant species identified by both methods. However, trawl sampling captured only two species (Emerald Shiner and Alewife) while terns delivered six species to chicks. Trawl-sampled fish were also larger on average than those delivered by terns. We conclude that both sampling methods contain biases but together provide a general view

of fish populations in the area.

### "COURTSHIP" FEEDING IN COMMON TERNS: ITS NUTRITIONAL FUNCTION AND EFFECTS ON EGG SIZE

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To quantify the nutritional importance of "courtship" feeding during clutch formation we (1) estimated the lipid and energy requirements of individual females, and (2) and compared these costs to the amount of food provided by their mates. Our data support a nutritional hypothesis for mate-provisioning: (1) the temporal pattern of food delivery by males matched the pattern of female energy requirement, and (2) based on our estimates of clutch production costs, the average male provided 40% to >100% (depending on time relative to laying) of his mate's daily nutritional requirement. However, there was considerable variation in provisioning rates among males. Does this variability in provisioning effort by males reflect variation in the size of eggs produced by females? Provisioning rate during the interval between first and second eggs was the only variable to explain a significant amount of variation in egg size. Contrary to expectation, females provisioned at higher rates produced clutches with lower total volumes, relatively smaller C-eggs, and took longer to complete their clutches than those females provisioned at lower rates. Could this observation represent an adaptive strategy employed by females?

### DESIGNING STUDIES TO EXAMINE THE EFFECTS OF HUMAN DISTURBANCE ON NESTING MARBLED MURRELETS AND SUMMARY OF PRELIMINARY RESULTS

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A pilot study was initiated in Oregon

and Washington in 1997 to test the effects of human disturbance on nesting Marbled Murrelets. To successfully test for the effects of disturbance on this secretive seabird: 1) active nests were monitored with an 8 mm infrared real-time video camera installed so that views of both the chick on the nest and adults perched on adjacent landing pads were obtained to record the behavioral response of both chick and adults; 2) cameras were installed within 1 meter of the nest to detect and record detailed behavioral changes as disturbances occurred and; 3) infrared capability allowed the recording of behaviors 24 hours, and during crepuscular periods, when adults and chick were most active. By matching the time of local disturbance recorded by ground observers with the video recordings at the nest, behavioral responses to disturbances could be recorded. Preliminary results indicate that adults are more affected by a variety of disturbances than chicks. Some human disturbances resulted in aborted feeding visits after adults were flushed from the nest limb or adults were prevented from making a feeding visit. Adults may respond differently to disturbances among sites due to acclimation to local background disturbances.

### SURVIVAL IN CASSIN'S AUKLETS ON SOUTHEAST FARALLON ISLAND: TEMPORAL PATTERNS, POPULATION VIABILITY, AND THE COST OF DOUBLE-BROODING

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Adult survival was estimated for Cassin's Auklets (*Ptychoramphus aleuticus*), using capture/recapture analyses of birds breeding in nestboxes on Southeast Farallon Island, California. Preliminary results indicate annual survival of c. 70% (S.E.=2%), with no sex difference in survival or recapture probability. Annual survival was similar across years except for 1982/83 and 1992/93 when survival was c. 50%. Average survival is very low compared to other studies of alcids, and substantially lower than what Gaston reported for a British Columbia population. These findings are consistent with the observation that Cassin's Auklets in CA (but not BC) are commonly double-brooded. We present a population dynamic model which demonstrates that low



adult survival of this population may account for the large drop in population size over the past 25 years, a drop of over 65%. In addition, we examine age-specific survival patterns and whether individuals that double-brood are more likely to survive (indicating differences in phenotypic quality) or less likely (indicating a cost of reproduction overriding any differences in quality).

# **FIFTEEN MILLION YEARS OF CHANGE IN THE MARINE ENVIRONMENT AND WHAT IT HAS MEANT FOR NORTHERN SEABIRDS**

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Extensive collections of fossil seabirds from the western North Atlantic document dramatic changes in seabird faunas of the northern oceans in the past 15 million years. Fourteen million years ago, the waters of mid-Atlantic region were warm temperate to subtropical with relatively few seabirds. This changed radically by 5 million years ago when presumed upwelling created a phenomenally rich marine environment with dozens of species of pelagic birds, including many that are now confined to the Pacific. There were five species of albatrosses, for example, including the three existing North Pacific species. A breeding colony of Short-tailed Albatrosses existed on Bermuda until about 450,000 years ago. Many extinctions took place in the North Atlantic, particularly of auks. Patterns of distribution were also very different, for example, there are absolutely no murrelets or guillemots in the North Atlantic during the Tertiary, the earliest yet known being a Pleistocene murre about 12,000 years old. The nature and possible causes of extinctions and changes in distribution will be discussed.

# **DEPTH AS A PREDICTOR OF SEABIRD AND FORAGE FISH ABUNDANCE IN PRINCE WILLIAM SOUND, ALASKA**

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We examined the relationship between abundance of all seabirds, abundance of Marbled Murrelets (*Brachyramphus marmoratus*), and forage fish biomass in relation to bottom depth at an intermedi-

ate scale. Working with the University of Alaska, Fairbanks, School of Fisheries and Ocean Sciences, we simultaneously collected hydroacoustic data on forage fish abundance and seabird locations in three study areas of Prince William Sound, Alaska (PWS). During July - August 1996 and 1997 we surveyed 22 nearshore survey blocks, 10 x 1 km, within 3 major study areas within PWS. Analysis of 1996 data was conducted using linear regression. Fish biomass did not predict seabird numbers; however, we determined that seabird abundance, Marbled Murrelets numbers, and forage fish biomass were negatively related to the mean bottom depth of the sampling blocks. We then used Geographic Information Software to illustrate the relationship between seabird distribution relative to depth using 1997 data. We suggest that our findings have resource management implications.

# **SUBTLE SIGNS OF EL NIÑO: THRESHOLDS AND SETPOINTS IN SEABIRD SURVIVAL**

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The 1997 El Niño event took the oceanographic world by surprise. None of the climate models accurately predicted the intensity of water warming or the rapidity of temperature change. By June, water temperatures throughout the Pacific Basin were 5-8°C above average. Plankton distribution and abundance anomalies were reported throughout the Pacific Northwest, including a massive coccolithophore bloom in the Bering Sea. Range extensions both north and south were reported for many species of mid and upper trophic level fishes. Was such a strong "bottom-up" signal detectable in the seabird community? Attendance, productivity, and foraging activity data for Common Murres (*Uria aalge*) in Washington State, indicate that murrelets, although certainly susceptible to the bottom-up regulation, did not appear to respond negatively. The reasons for the lack of response include: temporal and spatial buffering, behavioral accommodation, and location, location, location.

# **DISTANT WATERS: MANAGING FISHERIES AND SEABIRDS INTO THE 21<sup>ST</sup> CENTURY**

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By the 1970's, many world stocks of forage fish had collapsed from overfishing. Stock depletions were accompanied by significant declines in seabird populations and productivity (e.g., in Norway, South Africa, Peru), and gill-net mortality decimated some seabird populations (e.g., in Greenland, California). Consequently, many studies conducted during the past 25 years have focused on trophic relations of seabirds and mortality in fishing operations. Estimating net-mortality has been a relatively simple exercise in sampling and statistics; eliminating bycatch remains a socioeconomic and political issue. In contrast, seabird predator-prey interactions are complex and still poorly understood. Models evolved to assess trophic relationships: Energy- and time-budgets were measured, temporal and spatial scaling was applied, and multi-species interactions were evaluated. Models suggest that seabirds consume 10-30% of fish production near colonies, but management implications remain unclear. Recent studies involving concurrent measures of seabird population parameters and local prey dynamics suggest that seabird survival and productivity are not simple functions of prey abundance: Stochastic events (e.g., El Niño), regime shifts, behavioral buffers against prey fluctuations, non-linear predator-prey dynamics, and the over-riding influence of marine climate cycles, all befuddle our attempts to 'manage' seabirds and fisheries - and set our course of study into the 21<sup>st</sup> century.

# **COOK INLET SEABIRD AND FORAGE FISH STUDIES (CISEAFFS)**

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Populations, productivity, diets and foraging behavior of 6 seabird species (murre, kittiwake, guillemot, puffin, cormorant, gull) were studied during 1995-1997 at 3 seabird colonies in lower Cook Inlet (Chisik, Gull and Barren islands). Oceanographic measurements, seabird and hydroacoustic surveys, trawls, and beach seines were conducted in waters around (<40 km) each colony. Offshore and southern waters of Cook Inlet were dominated by juvenile walleye pollock

and capelin, important prey for murre and puffins. Nearshore waters of Cook Inlet were dominated by sand lance, which were consumed by seabirds (e.g., kittiwakes, guillemots, murre) in proportion to their local abundance. Forage fish densities ranged from 10's fish/m<sup>3</sup> (pollock) to 100's and 1000's of fish/m<sup>3</sup> (sand lance). Acoustically-measured forage fish biomass was lowest around Chisik Island, moderate in Kachemak Bay, and highest around the Barren Islands. Correspondingly, seabird densities at sea and seabird breeding success ranged from relatively low in the Chisik Island area to relatively high in the Barren Islands area. Populations of seabirds at Chisik Island continued a long-term decline, whereas populations at Gull and Barren islands are stable or increasing. Behavioral studies revealed that seabirds worked harder (longer foraging trips, less "free" time) at colonies where nearby fish densities were lower.

#### GEOGRAPHIC VARIATION AND REASSESSMENT OF SPECIES LIMITS IN THE "MASKED" BOOBIES OF THE EASTERN PACIFIC OCEAN

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Two distinct forms of Masked Booby (*Sula dactylatra*) occur in the eastern Pacific: (1) a yellow-billed form that includes a population on Clipperton Island and islands off western Mexico (*S. d. "californica"*), and another, unnamed, population on Las Islas Desventuradas, Chile, and (2) an orange-billed form (*S. [d.] granti*) that nests almost exclusively on the islands of the Galápagos and on Malpelo Island, Colombia. Quantitative comparisons, including Principal Components Analysis (PCA) of standard morphological characters indicated that yellow-billed populations are only marginally different from one another, and neither is consistently separable from *S. d. personata*, a yellow-billed form which ranges over most of the tropical Pacific. Further, we found no consistent differences in bare-part coloration or plumage among yellow-billed populations. In contrast, PCA clearly separated orange-billed from yellow-billed birds. The orange-billed bird is smaller with a significantly shorter, shallower bill, shorter tarsus, and longer wings and tail. It is also more sexually

dimorphic and has distinct plumage characters. Biological observations also support the distinctness of orange-billed birds. They typically nest on cliffs and steep slopes, whereas yellow-billed forms nest mainly on low, flat areas. A difference in habitat preference at sea resulted in a parapatric distribution: orange-billed birds away from colonies concentrated in nearshore waters off the coast of the Americas, whereas the yellow-billed forms foraged much farther offshore. Most importantly, orange- and yellow-billed birds paired assortatively where they nested sympatrically. Thus, based on morphological and biological differences, including assortative mating, we recommend that *Sula granti* be recognized as a separate species, the Nazca Booby.

#### DATA ON KNOWN-AGED CASSIN'S AUKLETS AT SOUTHEAST FARALLON ISLAND, CALIFORNIA

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Recruitment, nest relocation patterns, age of first breeding, and the effects of age and experience on reproductive success were examined for 706 breeding attempts by 267 known-age Cassin's Auklets (*Ptychoramphus aleuticus*); 123 females, 137 males, 7 of unknown sex) breeding on Southeast Farallon Island, California. Mean age of first breeding was 3.34 yrs ( $\pm 1.32$  SD; range 2-10 yr, mode 3 yrs, with 95.5% between 2 and 5 yrs). Mean natal dispersal distance was 15.83 m ( $\pm 23.95$ ; range 0[n=4] to 227.6 m). During 71.8% of nest relocations ( $X^2=15.02$ ,  $P = 0.000$  compared with 50%), birds moved nearer to their natal site. Adjusting for effects of year, reproductive success showed significant linear increases with both age and previous breeding experience. Effects of age appeared to be stronger than those of experience. An examination of lifetime reproductive success indicated that 4 was the optimal age to initiate breeding, compared with 3 as the most frequently observed age of first breeding. No sex-specific patterns were found relative to any of the above parameters.

#### METHODS TO ESTIMATE EFFECTS OF AN OIL SPILL ON WATERBIRDS IN NORTHERN CALIFORNIA

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We investigated the effects on the waterbirds of a small spill of about 5,000 gallons on November 5, 1997 within Humboldt Bay and as it moved offshore. With systematic boat surveys, we will be able to estimate the numbers of birds within and in the path of the spill. We documented the daily progress of the spill over 10 days. By 13 November oil had disappeared from most areas, and the number of oiled birds and the percentage of oil on plumages had greatly declined. There were apparent differences in the degree and areas of oiling between family groups of waterbirds. We will discuss preliminary examples of methods of determining the total number of birds affected by a spill and examining the extent of oiling on birds from water and shore-based surveys.

#### CORRELATION OF INLAND RADAR COUNTS AND MARINE POPULATIONS OF MARBLED MURRELETS IN WASHINGTON AND OREGON: A PILOT STUDY

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Marbled murrelet densities on the inland waters of Hood Canal, Puget Sound, were estimated from line transect surveys conducted once per month during the summer of 1997, concurrent with radar sampling at three adjacent drainages. Marine population estimates within 20 km, 30 km, and 40 km of radar sites were compared with radar counts. Monthly changes in densities were consistent within the 20-, 30-, and 40-km radii, and generally followed the trend of radar counts. Both marine densities and radar counts peaked in July, although the proportional increase in marine densities was much higher than that of radar counts. As expected, population estimates were larger than absolute radar counts, although the degree of difference depended on how the marine population was esti-



mated. Comparable radar counts and a lower marine population estimate within 20 km of the radar sites in June and July suggest that the potential population from which inland flights originate extends beyond 20 km in the WA study area. Radar and marine counts from the Oregon coast will be compared to results from Puget Sound. We discuss the implications of using marine counts and radar as complementary techniques in a regional monitoring program, and provide recommendations for future research

# RED-FOOTED BOOBIES INCREASE AND EXPAND DURING LAST 50 YEARS

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Red-footed Booby populations have increased and expanded during the last 50 years and colonized three sites; two colonies on the main Hawaiian islands and one in the Northwestern Hawaiian Islands. Sharp population increases in the 1970s, occurred during a period of high oceanic productivity associated with the Aleutian Low Pressure System, a component of the Pacific Decadal Oscillation (PDO) which increases ocean mixing. After oceanic productivity declined in the late 1980s, booby reproductive success declined. But population growth continued and since 1990, the populations of boobies have increased 60%. During this period, the tuna fishery in Hawaii continued to increase fishing effort and landings. Removal of predatory tuna may allow more prey to be available to boobies. Boobies may benefit from the removal of competitors but their commensal relationship with tuna requires tuna to drive prey to the surface. Either boobies are not fully commensal but rather opportunists, or there is a point when depleted tuna stocks will not be able to drive enough food to the surface to support the expanding booby populations.

# IDENTIFICATION OF MARBLED MURRELET NESTING STRUCTURES: A GUIDE FOR DETERMINING SUITABLE FOREST HABITATS IN THE PACIFIC NORTHWEST

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In recent years, the continuing efforts of researchers to identify and characterize Marbled Murrelet nesting sites has led to a better understanding of what constitutes

most suitable Marbled Murrelet forest habitats. The availability of nesting structures in a forest canopy has been shown to be a principal element in forest stands with high levels of murrelet activity. Nest selection appears to be highly dependent upon the availability of potential nesting surfaces, or platforms. The suitability of a stand is enhanced by processes which contribute to the number of potential nesting platforms. This field guide was developed to assist landowners and managers with implementation of the recently adopted forest practices rule in Washington state. It should also be helpful to others involved in management or research in the Pacific Northwest, for identifying forest structures that may contribute potential breeding habitat. A brief description of forest stand types utilized for murrelet breeding; a general platform definition; sampling methodology; and descriptions, illustrations and photographs of platform types are included.

# POPULATION DECLINES AMONG COMMON EIDERS BREEDING IN THE BELCHER ISLANDS, NWT

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Information regarding the status of Common Eiders breeding in the Canadian Arctic is lacking. In 1997, we surveyed five island archipelagos in the Belcher Islands in Hudson Bay from 3-23 July 1997. Our results were compared with surveys of the same islands completed between 1987-89 using a standard protocol. This study represents the first population trend data of any common eider population breeding in the eastern Canadian Arctic. 1416 nests were found on 431 islands; most (94.1%) while the female was still incubating. In every region, the number of nesting eiders declined significantly (overall 75%, range: 62.3%-84%). In 1997, nesting islands and adjacent waters were free of ice, eiders laid large clutches (range 4.0-4.4  $\pm$  1 SD), and they nested early. These conditions are indicative of a good nesting season, and we conclude that extensive non-breeding by female eiders in 1997 does not account for the decline. A winter die-off of eiders in 1992, which occurred when areas of open water froze, is the most likely cause of the decline. Our results present serious conservation concerns because eider populations are sensitive to reductions in adult

survival, and this population is harvested throughout the year by subsistent hunters.

# FORAGING HABITS OF THE CALIFORNIA LEAST TERN IN AND AROUND SAN DIEGO BAY

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The foraging habits of the California Least Tern were studied during four of its breeding seasons in San Diego Bay. The marine environment around San Diego Bay was divided into 32 polygons and each polygon was categorized as one of six foraging habitat types: ocean, channel, shore, inlet, mooring, or dock. Each breeding season was divided into four stages: courtship, egg, chick, and fledge. Transects were run via boat to determine whether Least Terns preferred to forage in specific habitats and/or locations. For each breeding season of each year, the majority of the polygons were not used. For years in which the study spanned the entire length of the breeding season (1994 and 1995), approximately 30% of the polygons not used at the beginning of the breeding season were consistently not used throughout the entire breeding season. Those polygons that were moderately or highly used varied both within and among years. Together, this suggests that locations in which no food is found are more significant, in terms of Least Tern foraging habits, than those in which food is found. Although there did not appear to be any preferred locations for foraging, there were two habitat types that appeared to be used more than others. These were the mooring and inlet habitats.

# RECENT ADVANCES IN ECOLOGICAL ENERGETICS AND NUTRITION OF SEABIRDS

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The field of avian energetics has seen major advances in the last 25 years, and seabirds have played a prominent role as models. Energy has been used as a currency for (1) assessing the fitness consequences of life history traits, (2) determining the impact of seabird predators on their prey, and (3) understanding the role of seabirds in marine ecosystems. Paradigm shifts in ecological energetics (e.g.,



optimization of energy allocation for reproduction) plus technological breakthroughs (e.g., doubly-labelled water) have resulted in considerable progress in understanding seabird life histories, especially time-energy constraints on reproduction. Associated with these constraints, some seabird taxa have evolved unique digestive strategies or abilities to digest refractory compounds. Only recently, however, have potential limiting nutrients other than energy been examined for their role in constraining seabird productivity. The nutritional ecology of seabirds promises to be an active area of research and discovery in the next quarter century, as will the continued expansion of bioenergetic approaches to understanding the foraging ecology of seabird populations and their role in marine ecosystems. The latter will be especially important for efforts to conserve seabird populations in the face of declines in food supply due to competition with fisheries and climatic change.

#### CASPIAN TERN PREDATION ON JUVENILE SALMONIDS IN THE COLUMBIA RIVER ESTUARY

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Recent establishment of a large Caspian Tern breeding colony on a dredge spoil island in the Columbia River estuary has raised concern over the potential impact on endangered salmonids. Photo census in 1997 indicated the colony exceeded 8,000 nesting pairs, the largest known Caspian Tern colony in North America, and more than a 600% increase in numbers since the colony became established in 1987. Nesting success, however, was very low; only about 5% of nesting attempts resulted in young raised to fledging. Diet in 1997 consisted of 86% juvenile salmonids, mostly coho and chinook smolts. The density of smolt PIT tags deposited on the surface of the colony indicates that the Caspian Tern population consumed millions of smolts in both 1996 and 1997. Bioenergetics modeling yielded a preliminary estimate of from 6 to 20 million juvenile salmonids consumed during the 1997 breeding season, a significant proportion of the smolt out-migration. Man-

agement alternatives focusing on Caspian Terns in the estuary may be effective and efficient components of a comprehensive plan to restore Columbia River salmon.

#### CENTRAL CALIFORNIA SHORELINE SURVEYS

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The Gulf of the Farallones National Marine Sanctuary conducts monthly and bimonthly surveys along 58 beach segments from Bodega Head (Sonoma County) to Año Nuevo (San Mateo County). Surveyors count coastal birds and quantify human beach use. We reviewed data from 13 beaches from October 1993 through June 1997. Representative analyses are presented. The most commonly observed species overall were Sanderlings (17.6/km surveyed), Brown Pelicans (13.2/km), Western Gulls (8.2/km), and Surf Scoters (6.3/km). The most abundant species and their numbers varied seasonally: during the Davidson period (November - February) Sanderlings (18.8/km) were the most abundant, followed by Surf Scoters (9.1/km) and Willets (5.1/km); during the Upwelling period (March - August), Sanderlings (10.4/km), Brown Pelicans, 4.6/km) Western Gulls (4.2/km), and Surf Scoters (4.8/km); during the Transitional period (September - August), Heermann's Gulls, (13.5/km), Brown Pelicans (11.8/km), and Western Gulls (10.9/km). Abundance of shorebirds was negatively correlated with the presence of people ( $r = -0.48$ ) and dogs ( $r = -0.45$ ).

#### EFFECTS OF DIET QUALITY ON POST-NATAL GROWTH OF SEABIRDS: CAPTIVE FEEDING TRIALS

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Declines in the availability of certain schooling forage fishes (sand lance *Ammodytes hexapterus*, herring *Clupea harengus*, capelin *Mallotus villosus*) have potentially contributed to the lack of recovery of some fish-eating seabirds that were injured by the Exxon Valdez oil spill. These forage fish tend to have high lipid content and, consequently, are assumed to

have high nutritional value as food for nesting seabirds. This study tests the hypothesis that composition of the diet is one factor constraining the growth and development of piscivorous seabirds. We raised seabird nestlings (Black-legged Kittiwakes *Rissa tridactyla* and Tufted Puffins, *Fratercula cirrhata*) in captivity on rations of either capelin, sand lance or herring as representative of high-quality forage fish, or walleye pollock (*Theragra chalcogramma*) as representative of low-quality forage fish. Experimental treatments included iso-biomass and iso-caloric comparisons of chick growth between low- and high-lipid fish types. Seabird nestlings fed rations of either sand lance, herring or capelin had much higher growth rates of body mass and somewhat higher growth rates of wing length than nestlings fed the same biomass of pollock. Differences in mass gain between nestlings fed capelin/sand lance/herring vs. pollock were more pronounced than differences in wing growth, suggesting that undernourished nestlings allocate food intake more to structural development than body mass. We conclude that when provisioning rate of seabirds to their young is constrained, the lipid content and nutritional quality of forage fish fed to nestlings has a marked effect on growth rates, and potentially, on reproductive success.

#### MURRE POPULATION COUNTS IN THE BARREN ISLANDS, ALASKA

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The Barren Islands in the northern Gulf of Alaska supported one of the largest breeding concentrations of murre (mostly Common Murres) in the path of the Exxon Valdez oil spill. During 1993-1997, we censused these populations as part of a series of Exxon Valdez Oil Spill Trustee Council-sponsored restoration studies designed to monitor postspill changes in numbers of birds attending the colonies. Counts were made from boats by two observers using standard Fish and Wildlife Service (FWS) protocols. Results were pooled with 1989-1992 FWS, 1990-1992 University of Washington (UW), and 1991 Dames & Moore (D&M) data and tested for trends with linear regressions at the 0.1 significance level. Although trends were not apparent in some postspill data sets, significant increases on

two plot sets and the fact that the 1997 counts were as high or higher than any of the 1989-1996 counts suggested that murre numbers may be starting to increase at the colonies. The presence of large numbers of nonbreeders in 1997, probably 3- and 4-year-old subadults from the strong 1993-1994 cohorts, also suggested that population recovery is underway.

# REPRODUCTIVE PERFORMANCE AND HABITAT SELECTION OF XANTUS' MURRELETS ON SANTA BARBARA ISLAND, CALIFORNIA

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Santa Barbara Island, California, supports the largest breeding population of Xantus' Murrelets in the United States. Channel Islands National Park has been monitoring the reproductive performance of Xantus' Murrelets on Santa Barbara Island since 1983. In 1997, we established two new plots in which potential sites were checked for occupancy and reproductive performance throughout the breeding season. We also investigated habitat characteristics of Xantus' Murrelet breeding areas. Specifically, we measured percent cover, density, and volume of shrub species. Our objectives were to (1) calculate an unbiased occupancy rate for Xantus' Murrelets on Santa Barbara Island, (2) compare reproductive performance and occupancy between plots, (3) investigate trends in reproductive performance and occupancy from 1983 to the present, and (4) identify factors that may affect Xantus' Murrelet site selection.

# THE COLONIZATION OF SOUTHERN SAN FRANCISCO BAY BY THE CALIFORNIA GULL FROM 1980 TO 1997

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Here we report the first breeding colony of California Gulls (*Larus californicus*) in coastal California. We document its increase in population, and the establishment of satellite colonies from 1980 to 1997. Breeding populations of California Gulls have typically occurred on lakes of the Great Basin and east of the Cascade-Sierra axis including a large colony at Mono Lake, California. In 1980, a breed-

ing colony of 12 California Gull nests was discovered on a series of small islets on Salt Pond A6 near the town of Alviso, Santa Clara Co., California. The population of California Gulls at this site has increased, reaching 1,111 nests in 1985 and 3,618 nests in 1995. Smaller colonies have since formed on salt pond levees at five other sites in southern San Francisco Bay. In 1997 there were 5067 nests at all sites. These colonies have been subjected to predation by introduced Red Fox (*Vulpes vulpes*). This predation has been followed by abandonment and reductions in breeding populations at several colonies. Additionally, there is a significant reduction in mean clutch size at several colonies where predation and population reductions have occurred.

# APPLICATION OF DIP NET CAPTURE TECHNIQUES TO ESTIMATE JUVENILE RECRUITMENT IN WINTERING POPULATIONS OF MARBLED MURRELETS

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Earlier success using spotlighting and dip netting as a capture technique for Marbled Murrelets in Desolation Sound, B.C. during the summer of 1997 has led to expansion of capture efforts for Marbled Murrelets in the Strait of Georgia during the winter of 1997-98. Dip netting is a relatively inexpensive capture technique that has the potential to yield high numbers of captures in a short time. Birds located on the water during the night are identified using a hand held spotlight, and are caught in a dip net while transfixed by the light. Captured birds are banded, weighed, measured, bled and released. By coupling dip netting with recent advances in distinguishing juveniles from winter plumage adults may allow us to calculate a ratio of juvenile/adult birds, which is an index of juvenile recruitment. Capturing birds using this method may also allow researchers to quantify juvenile/adult distribution of Marbled Murrelets in wintering areas, compare seasonal body condition of recaptured birds, permit survival estimation through application of mark/recapture models, and to band known age birds for future demographic studies.

# SPATIAL SCALING: THEORY AND

# APPLICATIONS IN MARINE ORNITHOLOGY

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Ecological questions in conservation biology, resource management, and impact assessment typically arise at medium to large scales, while ecological and ethological studies are carried out at small scales. One approach to this problem has been to ignore it. Another has been to define subsystems within a system, introducing correction factors as needed if summation is inaccurate. These correction factors are empirical, and hence cannot be applied to new situations. A theoretical approach is needed to obtain predictive scalings that can be tested against new data, then used to scale reliably from a survey or experiment to larger scale questions. Recently developed graphical methods make it possible to predict which of two rates will prevail at the scale of a study and at the scale of an ecologically important question. These graphs indicate that demographic rates (recruitment and mortality) do not scale as Area<sup>0</sup> nor do kinematic rates (lateral movements) scale as Area<sup>-1/2</sup>. Spatial allometry considers the scaling of rates to areas, lengths, perimeters, and volumes according to the principle of similitude introduced into biology by Thompson in 1917. Two ratio scale variables Q and Y are allometrically similar if they scale according to an exponent (b not equal 1) within a stated scope Y/Y<sub>0</sub>.

$$Q/Q_0 = (Y/Y_0)^b \quad \text{Hence: } Q = a Y^b$$

Spatially allometric functions have been developed for geophysical variables including coastline lengths, habitat islands, and rainfall. The next step will be to develop testable spatial scaling functions for biological rates. Marine birds, both on colonies and at sea, offer many opportunities for this. Marine ornithology continues to offer opportunities to make important and broadly applicable contributions to ecological theory.

# A COMPARISON OF BLOOD PARAMETERS BETWEEN PIGEON GUILLEMOT (*CEPPHUS COLUMBA*) COLONIES OF PRINCE WILLIAM SOUND AND KACHEMAK BAY, ALASKA

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Seven years after the *Exxon Valdez* oil spill, pigeon guillemot census counts at the Naked Island colonies continue to remain lower than pre-spill levels. It is unclear whether recovery is being limited by demographic constraints, food availability, or the physiological effects of oil contamination. We are studying these issues by comparing blood chemistry of pigeon guillemots between the oiled colonies of Naked Island, Prince William Sound and Kachemak Bay, which was not oiled in 1989. In 1996, several differences in the blood chemistry indicate a heightened immune response in pigeon guillemot chicks at Naked Island in comparison to Kachemak Bay. Higher Lymphocytes and gamma globulin are strong evidence for a heightened immune response. Heightened levels of liver enzyme SGOT are also, consistent with a heightened immune response. The acute phase protein, haptoglobin was significantly higher at Kachemak Bay. A logistic regression indicates that gamma globulin level alone largely distinguishes chicks between Naked Island and Kachemak Bay. The combination of gamma globulin, bile acid and phosphorus in a logistic regression model correctly classifies 53 of 54 chicks as from either Naked Island or Kachemak Bay.

#### AVOIDING SEABIRD BYCATCH IN ALASKA LONGLINE FISHERIES

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In 1995 commercial longliners fishing off Alaska caught two Short-tailed Albatrosses; in 1996 they took a third. The Short-tailed Albatross is one of the world's most endangered albatrosses - there are some 200 mating pairs and perhaps 900 birds alive today. The longline industry immediately developed a set of seabird-avoidance regulations modelled in part on the CCAMLR regulations for longline fishing in the Antarctic. These regulations were implemented in record time by the Secretary of Commerce. Assisted by federal agencies, Sea Grant, the Audubon Society, a private foundation and several private industry groups, the fishermen then engaged in a massive outreach program to get the word to the fleet. They also consulted with Dr. Hiroshi Hasegawa of Toho University, Japan, the world authority on the life-history of the Short-tailed Albatross. This presentation will review the reasons for and extent of the decline of the Short-tailed Albatross

population, and Dr. Hasegawa's pioneering work to restore it. It will discuss the legal and political realities surrounding the longline fisheries under the U.S. Endangered Species Act, and will describe the development and implementation of the seabird avoidance regulations. Finally an at-sea experiment is being devised to test the efficacy of the various seabird-avoidance fishing techniques and gear.

#### A SHIPWRECK RESPONSE PROGRAM TO PREVENT "RAT SPILLS" IN ALASKA

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Much attention has been focused damage to seabirds from oil spills, but less well publicized is the damage done by introduced rats on seabird nesting islands. Rats could be far more damaging than oil spills since rats survive even after wildlife populations are eliminated or reduced. Rats have been introduced to at least 22 islands in Alaska. Although intensive studies have not been done, it is apparent that burrow-nesting seabirds have been extirpated by rats, and these rodents also have reduced populations of crevice-nesters and possibly surface-nesters. Although rats have been successfully removed from several small islands in the world, such operations are costly and currently confined to fairly small islands. Clearly prevention of further introductions is a high priority. Ship wrecks are the primary means of introducing rats on uninhabited islands. Recently, the U.S. Fish and Wildlife Service, U.S. Coast Guard, Magone Marine (a ship salvage company) and others have developed a shipwreck response plan including development of a response network, stockpiling response supplies at strategic locations, training people in procedures, and increasing awareness about the problem.

#### HUMAN INFLUENCES ON BREEDING MARINE BIRDS OF THE NORTHEAST PACIFIC OCEAN - THE PAST 20,000 YEARS

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Human activities are known to significantly impact marine birds at nesting sites. Colonies at the continent edge of the Northeast Pacific Ocean have been ex-

posed to human influences since the last ice maximum, perhaps to 20,000 years before present. Did, could have, the First Americans significantly altered the abundance or distribution, or caused extinction, of marine avian species? Have the New Americans done the same? Has the form and extend of influences changed over time? How do these differ between the two groups, over time and between locations? Locations if California, Washington-British Columbia and Alaska are compared. Northeast Pacific Ocean sites are compared to those in tropical Pacific Ocean areas, where people of different origins and cultures first colonized oceanic islands. Archaeological, cultural, and recorded observations are utilized to explore and evaluate the above questions and developed hypotheses.

#### PATTERNS OF SEABIRD ABUNDANCE IN ASSOCIATION WITH OCEANOGRAPHIC FEATURES AT THE NORTH PACIFIC SUBTROPICAL FRONTAL ZONE

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During the spring of 1997 (25 April - 19 May), a survey of pelagic seabirds was performed concurrent with an investigation of the physical and biological oceanography of a broad region north of the Hawaiian Archipelago known as the North Pacific Subtropical Frontal Zone (NPSF) aboard the NOAA Ship *Townsend Cromwell*. The front is characterized by mesoscale features in the form of meandering fronts and frontal eddies in various stages of formation and decay. Seabird census transects (n = 127) were performed using a 300-m zone width and a 90° observation quadrant. Transects were 30 minutes in duration and were performed during daylight while the ship was underway between oceanographic stations. A number of long-term and several shorter duration studies have previously shown that seabirds have distinct affinities for water masses and physical oceanographic features. However, little attention has been directed at examining the role of mesoscale events induced by secondary divergent and convergent flow as important episodic habitat features for seabirds in this region of the central North Pacific Ocean. Seabird density is presented for species and species groups in relation to sea surface temperature and salinity, thermocline depth, and deep chlorophyll

## ABSTRACTS

maximum depth and concentration. Ecological significance and future research considerations are discussed.

### THE PACIFIC SEABIRD MONITORING DATABASE - A DESKTOP INFORMATION SYSTEM FOR NORTH PACIFIC SEABIRDS

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A 1992 Pacific Seabird Group survey of past and present seabird monitoring efforts in the temperate North Pacific indicated that upwards of 10,000 observations on seabird population parameters are available for North Pacific colonies. In a cooperative effort directed by the members of the PSG Seabird Monitoring Committee, the Pacific Seabird Monitoring Database was developed as a means of making these largely inaccessible data available to potential users in a timely manner. The database stores data on the 86 species that breed in the Pacific north of 20° N and incorporates a variety of population parameters including abundance, productivity, reproductive success, diet composition, and survival. Data to be collated in the database consists of observations replicated over time and of sufficient quality to permit meaningful trend and variability analyses. Each observation represents a yearly estimate of a particular population parameter for a given species in a given location. The database utilizes a run-time version of Microsoft Access for data entry, editing, querying, reporting and exporting, and includes Geographic Information System databases to be used with ArcView 2.1 for regional database querying, mapping, and spatial analysis capabilities. Currently, the database contains over 10,000 observations from four Pacific states (Alaska, Oregon, Hawaii and California), British Columbia, and the Russian Far East.

### FORAGING LOCATIONS OF MAGELLANIC PENGUINS IN THE SOUTH ATLANTIC

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Breeding Magellanic Penguins forage farther from their nest sites than was suspected prior to the recent use of satellite telemetry to track penguins at sea. We

have tracked Magellanic Penguins breeding on the Argentine coast for three years, and have found consistent patterns among seasons. During the incubation and late chick-rearing stages, breeding adults forage hundreds of kilometers from the nest site. Around the time of egg hatching and early chick-rearing, adults forage closer to the colony, but still make trips of tens to more than 100 kilometers. Such long distance foraging in a swimming bird imposes major constraints on rate of food delivery to, and consequently growth and survival of, chicks. In this paper, we compare Magellanic Penguin foraging patterns within and among years. Within the general patterns that are similar in all years, individuals differ markedly in their foraging locations; these locations appear to be consistent between trips. We also now have indications that penguins breeding in different colonies forage in the same area, indicating the possible use of regional foraging grounds.

### MARBLED MURRELET DISTRIBUTION SHIFTS BETWEEN COASTAL HABITATS OF NORTHERN CALIFORNIA AND OREGON

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A consistent seasonal change in the distribution of Marbled Murrelets relative to coastal nearshore habitat along the northern California and Oregon coast is described. Relative abundance decreased off most sandy shorelines and increased off from rocky shorelines in August compared with June. The shift in distribution occurred between late July and mid-August in each of 5 years, after many juveniles had fledged to sea and when most after hatch-year murrelets were entering the advanced stages of prebasic molt. This distribution shift has implications for monitoring the abundance and reproductive success of murrelets. Changes in the prey base, reproductive status, and molt condition of the murrelets are discussed as factors potentially related to the shift in distribution.

### FORAGING ECOLOGY OF BLACK-LEGGED KITTIWAKES IN PRINCE WILLIAM SOUND, ALASKA, FROM RADIO TRACKING STUDIES

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A nonlinear relationship between foraging effort and reproductive success has

been described for seabirds. The mechanisms and limitations of this relationship, however, are poorly understood. We studied the reproductive performance and at-sea foraging activities of kittiwakes during five seasons at colonies in north, central, and southern Prince William Sound (PWS). Mean annual foraging trip duration and distance from colony (linear distance over water to furthest foraging location) ranged from 1.7 hrs and 4.6 km for birds from a colony in central PWS to 6.0 hrs and 60.0 km at a northern colony. Adult kittiwakes were not able to maintain average nestling growth (16 to 17 g/day) when mean foraging trip durations were > 6 hrs and mean trip distances were > 40 km. Nestling diets were primarily pacific herring, pacific sand lance, and capelin. Foraging trip distance from colonies in central and northern PWS was inversely related to percent occurrence of herring in nestling meals. Greater mean trip distances were primarily associated with foraging locations around the southern boundary islands (near the Gulf of Alaska) where schools of sand lance and capelin were more prevalent than herring.

### TEMPORAL SHIFTS IN FISH AND ZOOPLANKTON SPECIES COMPOSITION IN SEABIRD CHICK DIETS OFF CENTRAL CALIFORNIA INDICATE MARINE CLIMATE CHANGE

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We used time series data (10 to 25 years) to assess temporal variation in prey composition of chick diets for 4 seabird species that breed on Southeast Farallon Island (37°N 123°W). The most prominent shift indicated from the three piscivorous species was a decline in proportion of juvenile rockfish fed to chicks. Prior to 1989 in years lacking warm-water anomalies, juvenile rockfish, mainly *Sebastes jordani*, made up more than 50% of the diet of Common Murre, Rhinoceros Auklet, and Pigeon Guillemot chicks. For the two species that forage farthest from the island, Rhinoceros Auklets and Common Murres, the proportion of northern anchovy increased in the 1990s. Pigeon Guillemots fed on cottidae species and other inter and subtidal fishes more frequently in the 1990s. Planktivorous Cassin's Auklets foraged mainly on the euphausiid *Thysanoessa spinifera* during the 1970s and early 1980s. Beginning in



## ABSTRACTS

the mid 1980s the proportion of *Thysanessa* in chick diets declined as the smaller euphausiid *Euphausia pacifica* increased. The decrease in prevalence of *Thysanessa* and juvenile rockfish from the 1970s to the 1990s occurred during a period of general ocean warming and may be explained by a change in upwelling in the region.

### SEASONAL CHANGES OF FOOD AND CHICK GROWTH IN RHINOCEROS AUKLET AT TEURI ISLAND: COMPARISON BETWEEN YEARS

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Regulation of food provisioning by parents in relation to chick growth has been studied extensively among seabirds during the last decade. To examine how parents adjust the provisioning to the potential food requirement of chicks, the seasonal changes of food and chick growth of Rhinoceros Auklets were measured for three years at Teuri Island. The fish species in bill-loads changed from juvenile Japan sea greenling, to sand lance, then to anchovy as the season progressed, in all years. Anchovy became predominant in late June and early July in 1995 and 1996, but not until late July in 1997, so the seasonal pattern of fish composition showed large annual variation. As the bill-loads composed of anchovy (c.30 g) were larger than those of sand lance (c. 20 g), the bill-load sizes peaked in late June and early July in 1995 and 1996, but in late July in 1997. The amount of food received by chicks and chick growth rates showed similar seasonal patterns. Fledging success was poor in 1997 (67%) compared to 1995 (81%) and 1996 (77%). Therefore, the timing of anchovy appearance is important for chick production. Parents might feed their chicks not by adjusting the food requirement of chicks, but largely according to the seasonal availability of their prey.

### THE UNITED KINGDOM SEABIRD MONITORING PROGRAMME: USE OF SEABIRD BREEDING PERFORMANCE AS AN ALERT FOR CHANGES IN THE MARINE ENVIRONMENT

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A co-ordinated, integrated monitoring programme at seabird colonies in the UK has been in operation for a decade. By the use of standardised methods to record breeding parameters such as chick output per nest, it is possible to describe changing spatial and temporal patterns in these parameters. This provides nature conservation organisations and others with a tool to provide an early alert on potential conservation problems. Several examples of the results of identifying such change will be given. Monitoring of productivity at Arctic Tern colonies in Shetland in the mid 1980s provided an early indication of a collapse in the local sand lance stock. A reduction in Black-legged Kittiwake breeding success on the east coast of Scotland led to concerns over the effects of the large-scale industrial fishery for sand lance in the feeding areas for colonies in this region. This concern has triggered a research programme on these possible links. Finally, the effects of two large oil spills on UK coasts can be put in context of natural variation in breeding numbers and productivity.

### DEMOGRAPHY OF THE BLACK SKIMMER IN SOUTHERN CALIFORNIA

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Black Skimmers first began nesting in California in 1972. Since then, skimmers have expanded northward into eight breeding colonies. Two of the largest colonies of breeding skimmers in the state are at the Upper Newport Bay and Bolsa Chica Ecological Reserves. In this study, I examine the demographics of the Black Skimmers at these two sites and, with the aid of a life table analysis, estimate the life expectancies of these birds through their various stages of life. Also, I compare southern California demographics with other studies done on skimmers throughout North America as well as with other related species. Data on phenology, clutch size, hatching success, fledging success, survivorship, mortality and life expectancy are presented. Southern California skimmers were found to follow the same general reproductive patterns as east coast and southern skimmers. Success

rates were found to be slightly lower here, but not enough to cause a net loss in population sizes. The Black Skimmer is an avian species that has shown an increase in population size due to good reproductive success and immigration.

### CHARACTERISTICS OF DOUBLE-BROODING IN CASSIN'S AUKLETS (*Ptychoramphus aleuticus*)

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Cassin's Auklets have a long incubation and nestling period, and yet on Southeast Farallon Island (SEFI), California, pairs have occasionally produced two successive clutches in a season. Double-brooding is rare in other seabirds, particularly other auklet species which inhabit more northern ranges and experience shorter breeding seasons. Breeding of Cassin's Auklets in nest boxes has been monitored on SEFI for 25 years (1972-1996). Our objectives are 1) to determine the frequency and success rate of double-brood attempts, 2) to describe environmental factors associated with double-brooding, 3) to examine characteristics of pairs which attempted double-brooding, and 4) to discuss the adaptive significance of double-brooding. Double-brooding occurred in 15 years of the study period, but in only 8 years did more than 10% of the monitored population double-brood. From preliminary analysis, attempts at double-brooding appear to be more successful in later years of our study, and additionally resulted in heavier fledglings than in earlier years. The mean first-brood lay date was earlier in years of attempted double-brooding. From a population of individually-marked breeders, we have determined that a number of specific birds or pairs have laid second clutches in more than one year.

### INTERNAL AND EXTERNAL MEASURES OF AGE AND BREEDING STATUS IN COMMON MURRE, WITH EMPHASIS ON THE BURSA

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For many reasons it is important to de-

termine age of seabirds. Within a few months of fledging, most seabirds, including murres, are relatively monomorphic in external plumage color and morphology, and they remain so until they die. As a result, bursa size and structure has been used for decades, often exclusively, as an indicator of reproductive potential and, indirectly, of age: Fleishy, thick-walled bursa = hatch-year to young subadult; non-fleishy, thin-walled bursa = reproductively immature subadult; membranous or absent bursa = reproductively mature adult. Similarly, in the absence of bursa data, birds with "full" size gonads have been assumed to be reproductively mature. However, both the literature and bursa data from Common Murres indicate that about 15% of breeding murres have thin-walled bursae, making bursa size alone an unreliable indicator of reproductive status. Similarly, birds with "fully enlarged" gonads often have fleishy bursae indicating that gonad condition alone is not a reliable indicator of reproductive maturity. We discuss these data in combination with data on bill length, bill depth, skeletal structure, and timing and extent of flight feather molt (and resulting plumage patterns), and how these data may be used to determine age and breeding status of murres more accurately.

#### MOLECULAR AND PHYSIOLOGICAL INDICATORS OF REPRODUCTIVE STATUS IN MARBLED MURRELETS

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Marbled Murrelets (*Brachyramphus marmoratus*) are sexually monomorphic seabirds (Alcidae) that breed in stands of old growth forest. The threats to such habitats raise concerns for the future conservation of this species, and point to the need for methods that can detect changes in Marbled Murrelet population demographics. The Marbled Murrelet's cryptic nesting behavior has made estimating even basic demographic parameters difficult. Blood and plasma samples were collected from Marbled Murrelets by mist-netting at Desolation Sound, British Columbia over four years (1994-1997), and dip-netting at both Desolation Sound, and Mussel Inlet, British Columbia during the 1997 field season. Red blood cells serve as ample sources of DNA for the application of a novel molecular sexing

technique, that was verified using DNA extracted from known-sex Marbled Murrelet museum specimens. Plasma triglyceride levels are greatly elevated during egg-formation, and serve as a means by which potential fecund (egg-producing) females may be identified within a sample of captured birds. We present sex ratio and plasma triglyceride levels of captured Marbled Murrelets, along with comparative studies in Cassin's Auklets, sampled on Triangle Island, British Columbia.

#### THE ECOLOGY OF BREEDING HARLEQUIN DUCKS IN A ROCKY MOUNTAIN VALLEY

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We have studied the breeding ecology of the Harlequin Duck, *Histrionicus histrionicus*, in the Maligne River Valley, Jasper National Park, since 1991. Our objective is to explain the abundance and distribution patterns of harlequins in this watershed. Macro-invertebrate community dynamics appear to be the major causal factor. Harlequins adopt either a territorial or mate-defense strategy for breeding in this valley. A few pairs of territorial birds breed on the Maligne River, while the majority are non-territorial and use one of two strategies: feeding at gathering, or 'club', sites at the Maligne Lake Outlet (MLO) and Medicine Lake, or spreading out around the lake margins to feed. These birds then move to higher elevation tributaries for nesting. We believe that the large variations in harlequin numbers observed at the MLO are likely caused by seasonal fluctuations in density and diversity in the invertebrate community. Understanding this phenomenon is crucially important for park management issues, as the Maligne River watershed is a high-use recreational area.

#### MOLECULAR INVESTIGATIONS INTO MECHANISMS OF SPECIATION IN THE AUKLETS (CHARADRIIFORMES: ALCIDAE)

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The conventional model of allopatric speciation does not provide satisfactory mechanisms for many evolutionary phenomena, such as adaptive radiations. Alternative models, such as those for parapatric, peripatric, and sympatric speciation, therefore have been proposed. The number and distribution of alleles within and among populations can provide clues as to the nature of historical population dynamics (bottlenecks, for example) causing or contributing to speciation. Four of the five species of auklets appear to have diverged within a short period during the late Pliocene or early Pleistocene, and their evolutionary relationships have been unclear despite over 3000 base pairs of mitochondrial sequence data analyzed. In the present study, we applied molecular methods to investigate mechanisms of speciation in the auklets. To determine whether species may have arisen through the founder-effect model of peripatric speciation, geographic variation in the MHC genes is being assayed to estimate effective population size at speciation. Analysis of nuclear introns and internal transcribed spacer regions of nuclear ribosomal DNA from individuals throughout the breeding range of the auklets are providing information concerning effective population sizes at different depths in the evolutionary history of these species. We also are attempting to determine whether ecological factors such as climate cycles, glacial refugia, and mutual sexual selection of ornamental characters played a major role in speciation within this group.

#### FORAGING CHARACTERISTICS OF COMMON MURRES; POTENTIAL INTERACTIONS WITH A SAND LANCE (AMMODYTES SPP.) FISHERY

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We present preliminary results of a multi-disciplinary program investigating the effects of large-scale industrial fisheries on non-target species (ELIFONTS). The study focuses on an area off the southeast coast of Scotland which has been the site of the highest intensity of



fishing recorded in the North Sea (maximum annual catch of >100,000 t of sand lance). The Common Murre is a key avian predator in the system and a major aim of this study is the determination of the foraging distribution, feeding behaviour and diet of this species. Data on foraging distribution were obtained by radio-tracking individuals and from at-sea surveys, information on behavior was collected both from the radio-tracked birds and from individuals fitted with time-at-depth gauges and diet was assessed by observations of prey brought back to provision the chicks. Results from the first field season indicate that 1 group sand lance were the most important item in the diet and that there was spatial and temporal overlap with the sand lance fishery. Individuals fed predominantly at depths of between 50-55 m, mainly on, or just above, the seabed. This finding accorded well with results from surveys of the vertical distribution of sand lance.

#### WHY STUDY PALEONTOLOGY? SOME ORNITHOLOGICAL ANSWERS

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Fossils are not simply a collection of bones, teeth, or impressions in rocks. Along with the morphological data one can gather from fossils is information about space and time. Each fossil and the surrounding rock provide information about morphology, when and where the fossil was deposited, and the fossils' depositional environment. From these data researchers can compare groups of fossils, possibly representing populations or ecological communities, deposited at the same time but in different places, or groups of fossils from the same place but deposited at different times. As such, fossils can be used in studies concerning (1) long term and large scale processes that have contributed to the development of extant ecological communities; (2) zoogeography of a taxon and the evolution of that taxon; and (3) morphological evolution. This talk will focus on how the study of fossils has contributed to our knowledge of seabird evolutionary processes occurring at these three scales. As examples, I will detail how fossils have furthered our understanding of the structure of north Pacific seabird "communities"; the evolution of the Alcidae, in particular the zoogeography of murre and guillemots (*Uria* and *Cephus*); and the

anatomy of Pelecaniform mandibles and the functional morphology of streptognathism.

#### FORAGING SITES OF JAPANESE CORMORANTS REARING CHICKS AT TEURI ISLAND: INDIVIDUAL AND BETWEEN-YEAR VARIATION

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Cormorants play an important role in inshore marine ecosystem as they consume large amounts of demersal fish. To study their response to and impact on the marine resources, it is important to know the variability of their foraging sites. Japanese Cormorants feed on demersal and epipelagic fish by diving to 10-20 m depths. We radio-tracked cormorants rearing chicks at Teuri Island in 1996 and 1997. They foraged at a single site for 81% of foraging trips either near the island (3-5 km from the colony) or the mainland coast (>20 km from the colony) with some individual site fidelity. All seven radio-tagged birds foraged mainly at sites near the mainland coast in 1996. In 1997, however, five out of ten radio-tagged birds foraged mainly at sites near the colony and the others near the mainland coast. The main diet of chicks was demersal fish (rock fish and greenling) in 1996 but both epipelagic (sand lance and naked sand lance) and demersal fish (greenling) in 1997. Therefore, availability of epipelagic fish might be one of the factors affecting their foraging distances.

#### ACTIVITY OF MARBLED MURRELETS AT EDGE AND INTERIOR FOREST LOCATIONS

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Inventory methods for Marbled Murrelets in British Columbia recommended that murrelet surveys be conducted in canopy openings to maximize bird detections. However, forest interiors are the focus of habitat management for murrelets. To determine if survey location influenced the detection of murrelets, we tested whether (1) observers had similar numbers of detections in clear-cut or adjacent forest edge and (2) there were associated differences in murrelet activity

between interior forest and edge stations. Seventeen sites, located in known murrelet nesting habitat in the Bunster Range, B.C., were randomly chosen along clear-cut edges. Each site consisted of three survey stations: open edge, forest edge and forest interior. Murrelet activity was recorded simultaneously at all three stations at each site. Results indicated that the total number of detections increased between May and July, 1997, but no differences in murrelet activity were detected between stations. Occupancy activity levels were higher in July for the forest interior stations, but no temporal changes in activity were detected at the edge stations. Future work should have a larger sample size, and the surveys should be combined with climbing plots to evaluate nesting density.

#### DIETARY PREFERENCES OF COMMON MURRES AND RHINOCEROS AUKLETS IN PUGET SOUND, WASHINGTON IN LATE SUMMER AND FALL 1993-1996

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Puget Sound is an important foraging location for large numbers of seabirds, particularly Common Murres (*Uria aalge*) and Rhinoceros Auklets (*Cerorhinca monocerata*). We present baseline data on the diet of these piscivorous seabirds collected from sockeye (late summer) and chum (fall) salmon drift gill nets in 1993-96. Overall, murre fed primarily on Pacific herring (74.2% of stomachs with contents), Pacific sand lance (45.8%), salmonid species (21.9%), Pacific tomcod (11.8%), Pacific hake (6.5%) and squid (5.9%). Auklets fed primarily on sand lance (62.3%), herring (48.1%), three spine stickleback (26.6%), squid (11.0%), tomcod (10.4%), salmonid species (9.7%), juvenile crab (7.8%) and Pacific sandfish (5.2%). Age (subadult and adult) and sex had no significant effect on the frequency of herring, sand lance, or salmonid species preyed upon by murre and auklets. Frequency of herring, sand lance, and salmonid species in the diet of both species did not vary significantly between years; however, during the sockeye fishery, murre ate significantly more herring and salmonid species than auklets. Overall, the mean length of herring and sand lance preyed upon by murre and auklets did not differ significantly. The depth and

## ABSTRACTS

time of day at which these birds were entangled will be examined to determine their role in the foraging ecology of these species.

### MANAGEMENT OF SEABIRD BYCATCH IN LONGLINE FISHERIES

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Seabirds are being taken incidentally in various commercial longline fisheries in the world. Species of seabirds most frequently taken are albatrosses and petrels in South Pacific and South Atlantic fisheries, Northern Fulmars in the North Atlantic and albatrosses, gulls, and fulmars in the North Pacific fisheries. Some of the seabird species have endangered or threatened status while others are species of management concern. Responding to the need to reduce seabird bycatch the Commission for the Conservation of Antarctic Marine Living Resources, the Commission for the Conservation of Southern Bluefin Tuna, and the N. Pacific Fisheries Management Council all adopted mitigation measures to reduce seabird bycatch in longline fisheries in 1992, 1992, and 1997, respectively. In 1997, the Food and Agriculture Organization's Committee on Fisheries agreed to conduct, in collaboration with the U.S. and Japan, the first worldwide meeting on seabird bycatch to develop a set of mitigation measures to reduce seabird bycatch in the world's longline fisheries. This technical meeting will occur in 1998;

while the measures will be considered for adoption by the FAO Committee on Fisheries in 1999.

### INDIVIDUAL FORAGING PREFERENCE OF THICK-BILLED MURRES DURING CHICK REARING

Kerry Woo\*<sup>1</sup> and Anthony J. Gaston<sup>2</sup>. <sup>1</sup>Department of Biology, University of Ottawa, Ottawa, Ontario, K1N 6N5, CANADA. <sup>2</sup>Canadian Wildlife Service, National Wildlife Research Centre, 100 Gamelin Boulevard., Hull, Quebec, K1A 0H3, CANADA. Kwoo@istar.ca

Thick-billed Murres (*Uria lomvia*) at Coats Island, NWT were observed delivering prey items to chicks during 1994 – 1997. Adults were marked using coloured leg bands allowing individual recognition. Feeding watches were carried out at regular intervals throughout the chick rearing period in each year. Prey items delivered to chicks were identified to species. Using observational data collected over four years we investigate trends in selection of prey items delivered to the colony by known individuals. Despite variations in overall prey availability during the chick rearing period, our data suggest that certain individuals show a preference for particular prey species or types (e.g. benthic vs. mid-water). Following known individuals, we examine foraging strategies relating to prey preference, looking at intra and inter-seasonal differences to determine whether the same individuals maintain or alter their prey selection from year to year.

### MONITORING HEALTH OF TROPICAL PELAGIC SEABIRD POPULATIONS IN HAWAII

Thierry M. Work\* and Robert A. Rameyer. USGS-BRD National Wildlife Health Center Honolulu Field Station, PO Box 50167, Honolulu, Hawaii, 96850, USA. Thierry\_work@usgs.gov

Since its establishment, the Honolulu Field Station used clinical and microscopic pathology, toxicology, microbiology, and epizootiology to evaluate health of seabirds in Hawaii. From 1992-1996, the HFS examined tissues from 1775 seabirds comprising 15 species. Diseases were grouped into those causing large-scale mortality and those considered incidental. Lead poisoning from paint chips and necrotizing enteritis secondary to dehydration were major causes of mortality in Laysan Albatross chicks on Midway Atoll. Lead poisoning in Laysan Albatross chicks increased in severity with age and was more prevalent near buildings. On Oahu, unusually strong winds along with bacterial infections were responsible for large mortalities of shearwater chicks in 1994. Unusually high numbers of Laysan Albatross adults died on Midway in 1995 from acute anemia of unknown origin. In 1996, fire was responsible for deaths of Red-footed Boobies on Oahu. Incidental findings included trauma and parasitic infections such as newly described endemic blood parasites from Great Frigatebirds and Brown Boobies. At present, disease does not appear to play a limiting role in seabird populations in Hawaii. However, given the dynamic nature of disease, population health should be integrated into monitoring systems for seabirds.



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# BOOK REVIEWS

## BOOK REVIEWS AND RECENT LITERATURE

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**RECORDS OF BIRD SKINS COLLECTED ALONG THE OREGON COAST.** Range D. Bayer. Studies in Oregon ornithology number 7. Gahmken Press, P.O. Box 1467. Newport, Oregon 97365. 1989. 246 pp. \$20.00. ISBN 0-939819-06-6 (paperback).

This publication is a catalog of specimens of birds collected along the Oregon coast, found in over 80 museums, that includes over 11,000 skins of 279 species of birds, and 192 skeletons of 52 bird species. "Each record includes the species, subspecies (if given), sex or age class, date of collection, location of collection, collector, and museum number. Each record is indexed by species, subspecies, collection site (i.e., county, beached or pelagic specimen, offshore island, lake and/or shell mound), and collector."

There are six major sections, the introduction and methods, simple analyses of records, tables of specimens by museum (the bulk of the document), appendices, literature cited and indexes. Of interest, is the inclusion of literature references to specimens. Tables include a list of numbers of specimens found in responding museums and ranking of museums by totals - 30% are in the Cleveland Museum of Natural History. Of interest, only 30% of all specimens located are housed in Oregon collections. Specimens of the Song Sparrow are most numerous (674). Of seabirds, Western Gull specimens are most numerous (291) followed by Red Phalarope (208), Common Murre (202), Leach's Storm-Petrel (164), Tufted Puffin (158), Red-necked Phalarope (147), Cassin's Auklet (137), and Sooty Shearwater (136). Only 12 skeletons were found of the Common Murre, the most common of seabirds. Of the total specimens, 59% were from Tillamook County, and 49% of

the total were collected between 1930 and 1939, 13% in 1910-1919, 12% in 1920-1929, 13% in 1940-1949, 5% in 1950-1959, and 2% for each next decade. The efforts of individual collectors is reflected by Alex Walker accounting for 41% (n=4,724) of all specimens found, with those attributed to him found in 28 different collections. S.J. Jewett collected at least 1,979 specimens, 17% of specimens found. What is not clear in the museum tables is the portion of seabirds that were actually taken and the portion that represents salvaged birds, found dead on ocean beaches. From my own experience there are details of "wrecks" on museum labels but not documenting such details for this reported project is understandable - the lists provided allow others to focus on specific species of interest.

The remaining sections are also of interest and useful. Appendix one is a list of specimens that have been "lost" from the Oregon State University Museum (n=403), a reflection that once in a museum specimens are not necessarily secure. Appendix V is a list of the numbers of specimens collected by each collector, by decade. Finally the index of species collected is cross referenced by common and specific name, with each entry linked to the collection(s) where in specimens are housed. Thus the user is able to determine the field collection location of all specimens of each species and determine the present museum location.

This publication represents a tremendous amount of work, as is evident by the detail and thoroughness of the investigation presented.

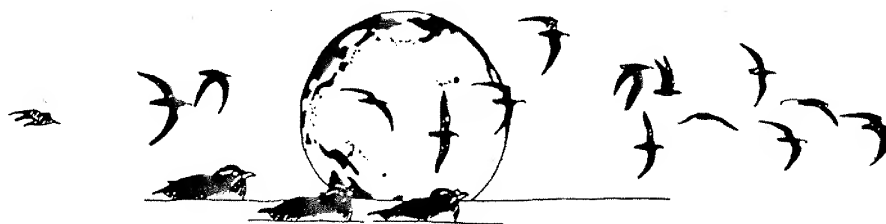
By *Steven M. Speich*

**SEABIRDS.** Mark J. Rauzon. A First Book. Franklin Watts, New York. 1997. 63 pp. \$6.95. ISBN 0-531-15817-9 (paperback).

The young minds that inhabit our grammar and middle schools will find this a well written, brightly illustrated and fascinating introduction to the lives of seabirds. There are eight chapters, including an introduction that describes in general terms the ocean environment of seabirds and briefly how seabirds interact therein. There are five chapters, each describing the biology of a major group of seabirds, omitting the diving petrels. The next chapter addresses the character and biology of seabird colonies. The last chapter discusses aspects of the conservation and threats to seabirds, including oil spills and fishing. There are 28 full color pictures, many full-page, clearly showing individuals of the various seabird groups and their environment, at sea and on colonies. Perhaps the major elements lacking are the hardships and endurance required of seabirds to face and survive the full force of winter storms at sea - a difficult task for any book on seabirds. Otherwise Mark has achieved a balance between the need to include technical information (just enough) and presentation (style) to hold the interest of young readers.

With a world population approaching 6,000,000,000 individual humans the task of educating our children of environmental concerns in general, let alone of seabirds, is a daunting but necessary responsibility of all seabird biologists. With this book Mark has made his contribution, among many others, to this end; we all could follow his example, even with just one contribution of kind.

By *Steven M. Speich*



**A SYMPOSIUM OF THE PACIFIC SEABIRD GROUP**  
**BIOLOGY OF MARBLED MURRELETS: INLAND AND AT SEA**  
S. KIM NELSON AND SPENCER G. SEALY (editors)

in NORTHWESTERN NATURALIST, Volume 76, Number 1, 1995

**CONTENTS**

Introduction by S. K. Nelson and S. G. Sealy

*Inland*

Marbled murrelet activity relative to forest characteristics in the Naked Island Area, Prince William Sound, Alaska by K. J. Kuletz, D. K. Marks, N. L. Naslund and M. B. Cody

Tree and habitat characteristics and reproductive success at marbled murrelet tree nests in Alaska by N. L. Naslund, K. J. Kuletz, M. B. Cody and D. K. Marks

Description of two marbled murrelet tree nests in the Walbran Valley, British Columbia by I. A. Manley and J. D. Kelson

Characteristics of three marbled murrelet tree nests, Vancouver Island, British Columbia by K. M. Jordan and S. K. Hughes

Marbled murrelet distribution in the Siskiyou National Forest of southwestern Oregon by C. P. Dillingham, R. C. Miller and L. O. Webb

Two marbled murrelet nest sites on private commercial forest lands in northern California by S. J. Kerns and R. A. Miller

Behavior of marbled murrelets at nine nest sites in Oregon by S. K. Nelson and R. W. Peck

Fledging behavior, flight patterns, and forest characteristics of marbled murrelet tree nests in California by S. W. Singer, D. L. Suddjian and S. A. Singer

Use of boat-based surveys to determine coastal inland habitat associations of marbled murrelets in Prince William Sound, Alaska by D. K. Marks, K. J. Kuletz and N. L. Naslund

Use of radar to study the movements of marbled murrelets at inland sites by T. E. Hamer, B. A. Cooper and C. J. Ralph

*At Sea*

Preliminary observations on juvenile:adult ratios of marbled murrelets in Auke Bay, southeast Alaska by H. L. Anderson and S. R. Beissinger

At-sea activity patterns of marbled murrelets adjacent to probable inland nesting areas in the Queen Charlotte Islands, British Columbia by M. S. Rodway, J.-P. L. Savard, D. C. Garner and M. J. F. Lemon

Decline of marbled murrelets in Clayoquot Sound, British Columbia: 1982-1993 by J. D. Kelson, I. A. Manley and H. R. Carter

Distribution of marbled murrelets along the Oregon Coast in 1992 by C. S. Strong

Use of mist nets to capture murrelets over the water by R. A. Burns, G. W. Kaiser and L. M. Prestash.

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**SHOREBIRDS IN MARINE ENVIRONMENTS.** Frank A. Pitelka (Editor). Proceedings of an International Symposium of the Pacific Seabird Group. Asilomar, California, January 1977. Published June 1979 in Studies in Avian Biology, Number 2. Out of print.

**TROPICAL SEABIRD BIOLOGY.** Ralph W. Schreiber (Editor). Proceedings of an International Symposium of the Pacific Seabird Group, Honolulu, Hawaii, December 1982. Published February 1984 in Studies in Avian Biology, Number 8. \$12.00.

**MARINE BIRDS: THEIR FEEDING ECOLOGY AND COMMERCIAL FISHERIES RELATIONSHIPS.** David N. Nettleship, Gerald A. Sanger, and Paul F. Springer (Editors). Proceedings of an International Symposium of the Pacific Seabird Group, Seattle, Washington, January 1982. Published 1984 as Canadian Wildlife Service, Special Publication. Out of print.

**ECOLOGY AND BEHAVIOR OF GULLS.** Judith L. Hand, William E. Southern, and Kees Vermeer (Editors). Proceedings of an International Symposium of the Colonial Waterbird Society and the Pacific Seabird Group, San Francisco, California, December 1985. Published June 1987 in Studies in Avian Biology, Number 10. \$18.50.

**AUKS AT SEA.** Spencer G. Sealy (Editor). Proceedings of an International Symposium of the Pacific Seabird Group, Pacific Grove, California, December 1987. Published December 1990 in Studies in Avian Biology, Number 14. \$16.00.

**STATUS AND CONSERVATION OF THE MARBLED MURRELET IN NORTH AMERICA.** Harry C. Carter, and Michael L. Morrison (Editors). Proceedings of a Symposium of the Pacific Seabird Group, Pacific Grove, California, December 1987. Published October 1992 in Proceedings of the Western Foundation of Vertebrate Zoology, Volume 5, Number 1. \$20.00.

**THE STATUS, ECOLOGY, AND CONSERVATION OF MARINE BIRDS OF THE NORTH PACIFIC.** Kees Vermeer, Kenneth T. Briggs, Ken H. Morgan, and Douglas Siegel-Causey (Editors). Proceedings of a Symposium of the Pacific Seabird Group, Canadian Wildlife Service, and the British Columbia Ministry of Environment, Lands and Parks, Victoria, British Columbia, February 1990. Published 1993 as Canadian Wildlife Service, Special Publication, Ministry of Supply and Services, Canada, Catalog Number CW66-124-1993E. Free. Write: Publications Division, Canadian Wildlife Service, Ottawa, Ontario, K1A 0H3, Canada.

**BIOLOGY OF MARBLED MURRELETS - INLAND AND AT SEA.** S. Kim Nelson and Spencer G. Sealy (Editors). Proceedings of a Symposium of the Pacific Seabird Group, Seattle, Washington, February 1993. Published 1995 in Northwestern Naturalist, Volume 76, Number 1. \$20.00.

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Pacific Seabird Group Symposia are initiated by one or more persons with interest in a particular topic area, resulting in a collection of papers usually presented at an annual meeting of the Pacific Seabird Group. Some symposia are further refined and then published as a Symposium of the Pacific Seabird Group. Individuals interested in promoting future symposia must first contact the Coordinator of the Publications Committee, and the appropriate annual meeting scientific program coordinator, prior to initiating the process leading to the actual symposium session and possible publication. The necessary guidelines outlining the steps and responsibilities for obtaining approval, organizing, holding and publishing Pacific Seabird Group Symposia will be provided. This opportunity is available to all members of the Pacific Seabird Group.



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